UNITED STATES ARMY DECEMBER 1967

AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

DIRECTOR OF ARMY AVIATION, ACSFOR DEPARTMENT OF THE ARMY

COL Edwin L. Powell Jr.

COMMANDANT, U. S. ARMY AVIATION SCHOOL

MG Delk M. Oden

ASST COMDT, U. S. ARMY AVIATION SCHOOL

COL M. H. Parson

DIGEST EDITORIAL STAFF

MAJ L. J. Herman Jr., Editor-In-Chief
Richard K. Tierney, Editor
William H. Smith
Diana G. Williams
John P. Jones

GRAPHIC ART SUPPORT

Harold G. Linn
Harry A. Pickel
Dorothy L. Crowley
Angela A. Akin

DIRECTOR, U. S. ARMY BOARD FOR AVIATION ACCIDENT RESEARCH

COL Warren R. Williams

USABAAR EDUCATION AND LITERATURE DIV

Pierce L. Wiggin, Chief
William E. Carter
Ted Kontos
Charles Mabius
Mary W. Windham

DECEMBER 1967 VOLUME 13 NUMBER 12

LETTERS 1

CONSTRUCTION POWER AND AIR POWER, MG Robert F. Seedlock 2

TV, MAJ Robert D. Morgan and Mr. John Krickel 6

IN THE BALANCE, CW2 Stanley Q. Coss 10

MILITARY LEADERSHIP, SGM Glenn E. Owens 12

17TH COMBAT AVIATION GROUP, CPT Barry J. Nelson 14

AIRMOBILE ENGINEERS, CPT Gene A. Schneebeck and CPT Richard E. Wolfgram 18

THE IMPROVED CHINOOK, Truxtun R. Baldwin 22

COBRA NETT 28

TALES OF A TIRED T-41, CPT Steven E. Selman 29

COURTESY AND COMMAND SENSE, CPT Adam E. Runk and CW2 Carl L. Hess 31

CAN DO, LTC Kenneth D. Mertel 32

CRASH SENSE 36

THE HURRICANE, CW3 John G. Daneker 48

PEARL'S 50

THE TA FUEL CONTROL: ITS OPERATION 54

STATIC SPARKS, Ted Kontos 60

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

The DIGEST is an official Department of the Army periodical published monthly under the supervision of the Commandant, U. S. Army Aviation School. Views expressed herein are not necessarily those of Department of the Army or the U. S. Army Aviation School. Photos are U. S. Army unless otherwise specified. Material may be reprinted provided credit is given to the DIGEST and to the author, unless otherwise indicated.

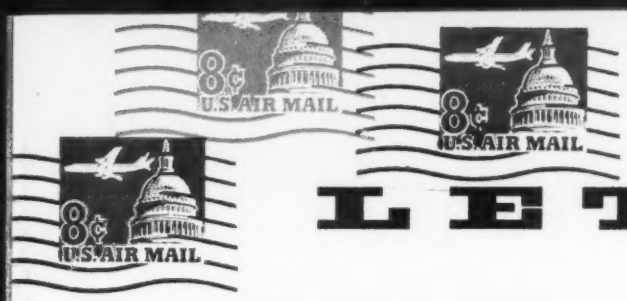
Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U.S. Army Aviation Digest, Fort Rucker, Alabama.*

Use of funds for printing this publication has been approved by Headquarters, Department of the Army, 29 December 1964.

Active Army units receive distribution under the pinpoint distribution system as outlined in AR 310-1, 20 March 62, and DA Circular 310-57, 14 March 63. Complete DA Form 12-4 and send directly to CO, AG Publications Center, 2800 Eastern Boulevard, Baltimore, Md. 21220. For any change in distribution requirements, merely initiate a revised DA Form 12-4.

National Guard and Army Reserve units submit requirements through their state adjutants general and U. S. Army Corps commanders respectively.

For those not eligible for official distribution or who desire personal copies of the DIGEST, paid subscriptions, $4.50 domestic and $5.50 overseas, are available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., 20402.



LETTERS

Sir:

Wouldn't you like for your posterity to know what you've done for your country? "Sure," you say, "I'd like that." I think this fairly well sumes up the attitude of most men, specifically Army aviators, but the unfortunate thing about this statement is that little is done other than simply talk about it.

What we need in Army aviation today is some action to preserve the accounts of heroic acts which are taking place daily in Vietnam by Army pilots. Let us record this new era of the Army concept, helicopters, and the men who are doing these heroic deeds. Let's record it with pictures, names, and places in a place called the ARMY AVIATION MUSEUM.

The Air Force at Wright-Patterson AFB in Dayton, Ohio, started the first big aviation museum. I've been fortunate enough to go through their museum and look at the almost unending accounts of the great stories of the men and machines who started flying on its way to what it has become today. Their story tells of the first pilots in aviation, then proceeds onward into World Wars I and II, the Korean War, plus their newest inventions in aircraft, flight suits for supersonic speeds, outer space, etc. Granted the Air Force has a much longer history than has Army aviation, it's about time we brought our history, deeds, and facts, along with whatever else need be, up to date.

I've also had the opportunity to wander through the growing Navy museum at Pensacola, Fla. Here again, the great men of the air are brought forth through the mediums of pictures, writings and drawings. As I walked through I could imagine myself at the place I was looking at. The museum takes you through all phases of the aviation program, the basics of flight training up to and including the combat eras of the professionals of both the Pacific and Korean campaigns. Here again the public has a dynamic program before their eyes to wonder about. This in itself makes the pilots proud to be pilots. This is their past.

While strolling through the Navy museum, I gained a sense of pride knowing that pilots do overcome great odds to do a job well—a job that directly affects the outcome of the conflict. Although I was proud to be a pilot, there still remained the fact that I wasn't looking at an Army display, but at another display of a sister Service.

I started thinking that if the Navy and Air Force can have museums to show all who come what they have done, then why can't we as Army pilots get us a showroom for the world to enter into? Why can't we be proud of what we are doing now, have done, and I'm certain will continue to do in the future? Let's show that we have conquered a few goals ourselves. Let's look at our past.

Lastly, I went to the Army Aviation Museum at Fort Rucker, Ala. We tell the story of our program somewhat, but entirely too little is told. We aren't telling the story of our men of aviation. We must include the people who are doing the work for the Army. Also, we must make our static displays more presentable. The aircraft which are our "firsts" are in bad need of help. They need those new windows, blades, paint, etc., that make them look like museum pieces, not antiques in a junk shop. We have made great progress in our aviation program in the last 15 years, both in men and machines. We should show these progressions as we go along. We must show our past.

I realize that we do not have all the glamorous, sleek jet aircraft, nor the spruced up flight suits that make everything a little more interesting. We can't account for enemy airplanes shot down, which brings forth the air aces, but we do have men who have performed great feats with their helicopters. Let's record the actions of these men.

Let's take our heroes from the battles of Ben Gia, Dong Xoai, and numerous others and tell their stories. Let us tell about the men who flew the medevacs in and out of the battle areas 24 hours a day the year around. We should tell of all our men who for the first time saw the Viet Cong thrown back in defeat because of the daring and hard work of Army aviators. Let's tell the world that we do exist through our new aviation museum.

Why shouldn't we have a museum so we can get our "firsts" in helicopters in out of the weather? Put our "greats" pictures on the walls to show the world we do have people who can stand with the best? We must be aware of our past. Let's remember our heroes, our pride.

CW2 CARL A. COYAN
Fort Rucker, Ala.

• *Great concern for the preservation of the history of Army aviation has been expressed in recent years. While a "museum" has existed for some time, a real impetus was given the program last year with the hiring of a full-time museum director and a curator. While awaiting acquisition of a larger, more adequate building, the staff is hard at work developing plans for telling the Army aviation story. History buffs hope this will be the beginning of acquiring more adequate facilities to build an Army Aviation Museum that can reflect the proud history of the Army's men and machines in aviation.*

—The Editors

Sir:

I have just read the letter from SSG Campbell in the October issue of the DIGEST and agree with the answer that CPT Ferguson gave in regard to the Senior Aircraft Crewman Badge. However, for the award of the Aircraft Crewman Badge the regulation reads a little different. I refer to the last sentence of para 108.5a, which says, "Concurrent with such assignment, these personnel are authorized to wear the Aircraft Crewman Badge until relieved from such duty *or* until such time as he fulfills the mandatory requirements for the permanent award." Paragraph b states, "An individual who has performed in one of the duties specified in "a" above, for not less than 12 months (not necessarily consecutive) *or* is school trained for a principal duty contained in "a" above, will be authorized to wear the Aircraft Crewman Badge permanently."

I interpret the regulation to read that if an individual has completed a service school for one of the principal duties listed in the regulation he can be awarded the badge, regardless if he is or has ever been on flying status.

. . . I would appreciate your comment, as the words "or" in both paragraphs tend to confuse me and other personnel in my unit.

. . . Thank you for your attention in this matter and I hope you can make clear the many different interpretations that we have.

NAME WITHHELD

Continued on page 64

25th ANNIVERSARY CONTRIBUTION

Construction Power and Air Power

Major General Robert F. Seedlock
Commandant, U. S. Army Engineer School

ON 20 JANUARY 1945 a truck convoy rolled across the Burma-China frontier for the first time since the Japanese cut off China from the outside world in 1942. It was a convoy of American trucks with supplies and material from India which had traveled the Ledo and Burma roads over some of the most rugged terrain in the world.

This accomplishment was significant because of the engineering and air support that made such a feat possible. The construction power of the Army Engineers supports the combat power of our Army and Air Force, and of ever-increasing importance is the support of engineer construction power by aviation.

Airmobility is now an accepted way of life in the Army. Through evolution it has become a basic concept of engineer support to military operations. Although airmobility and air support for engineers have come into their own in the last 10 years, we can look back to the combined efforts of construction and airmobility power in the China-Burma-India theater of operations and see the beginnings of this great potential.

Probably no other major road-building job in peace or war depended so much upon the airplane for supply and support as did the Burma Road and its associated network in that theater. Crude by any standard, with sharp curves and steep grades, the old Burma Road was the principal trade route overland to China until it was closed in 1942. China's lifeline, which had carried about 13,000 tons a month, was sealed by the Japanese.

One of the principal objectives of the Allies was to provide supplies and war materials to the embattled Chinese. To meet this initial objective, the U. S. Air Transport Command established the now famous air route over "The Hump." This gallant effort relieved the blockade tremendously and for a time was the only supply route from the outside world. Yet, this was not enough. The overland route had to be opened.

Responsibility for maintenance of the road inside China was given to the Yunnan-Burma Highway Engineering Administration under the Chinese Cabinet Minister of Communications. The American element, the Burma Road Engineers, provided assistance and advice as well as active engineering support to Chinese armies in the field. This element varied from 750 to 3,500 officers and men, who for the most part were experienced highway engineers and skilled equipment operators. The Chinese labor forces peaked at 20,000.

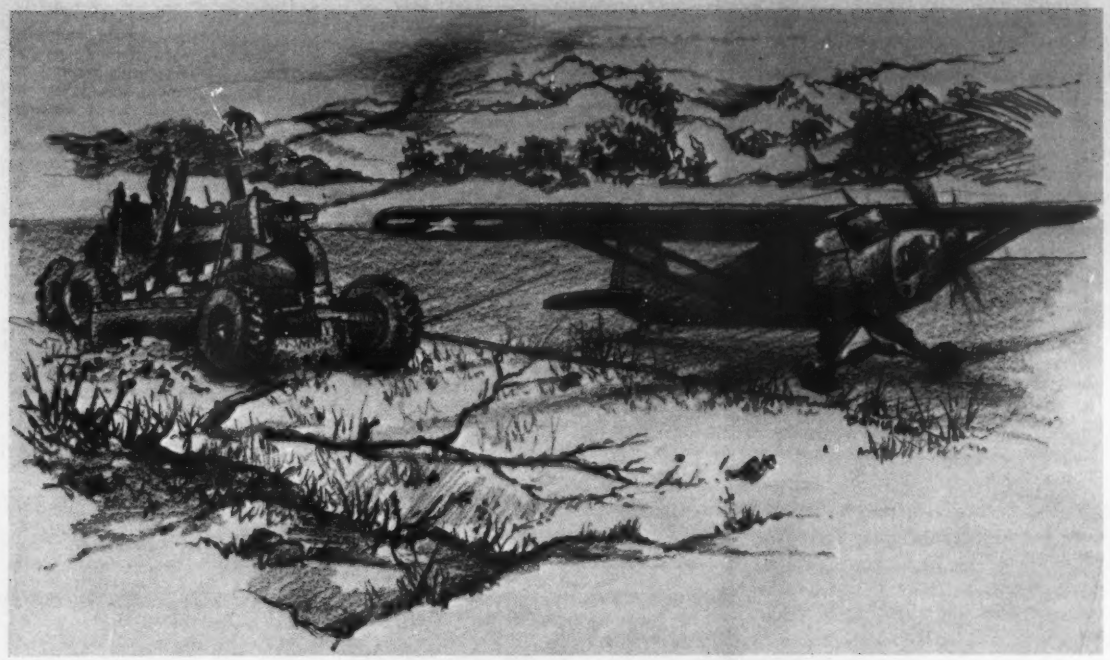
In the spring of 1944, air tonnage could be spared for the road operation for the first time. The airlift of construction equipment greatly enhanced the progress on the road and the ultimate transport of much needed supplies.

The procedure for supplying the troops at this time was to fly in arms, ammunition and other vital material from the Chabua area to Yunnanyi and Kunming and then truck them down the Burma Road from these fields. The joint efforts of the American Air Forces and the American and Chinese engineers were unique in keeping open this vital supply line.

Reequipping of the Chinese armies had progressed to the point that the Chinese Expeditionary Force could jump off on 5 June 1944 across the Salween River as one jaw of the pincers to meet General Stilwell's offensive coming down from North Burma at that time.

The American Burma Road Engineer organization had some valuable airmobility of its own in the form of three L-5 aircraft. These provided much the same service as light aircraft do for our engineers today — command and control and engineer reconnaissance. In China and Burma, as in Vietnam today, these functions would have been either impossible or highly impractical without aircraft.

Construction of the Ledo-Burma Roads, bypasses, and pipelines could not have been accomplished with such speed and efficiency had it not been for the widespread use of aircraft. Engineer reconnais-



Construction power and air power have been working hand and hand from World War II through Vietnam. Above, an Army Cub supports engineers at work in the China-Burma-India theater of operations. Below, the Army's CH-54A Flying Crane lifts a bulldozer in support of engineers in Vietnam

sance, command, and control could never have been effected without the light L-5 aircraft available to my engineer planners, whom I praise as the finest any commander ever had the privilege of working with.

By today's standards, we cannot say that we had true airmobility in World War II, but it was a humble beginning from which valuable lessons were learned. Engineer construction equipment could be airlifted into isolated areas, even if it meant flying in the components and reassembling them on the site. As we shall see, sectionalization and rapid reassembly are common in the airmobile concept of today.

The traditional support of Army forces by their engineers is well known—roads, bridges, obstacles, railroads, ports, and construction of hospitals, depots and a multitude of other facilities. From World War II on, airfield construction became one of the largest missions ever undertaken by engineers.

During the Korean War, engineers continued to reap benefits from aviation support. In the early phases of the war much of the engineer equipment and material was flown into Korea. In September 1950, an M4 floating bridge was airlifted from Japan to Kimpo Airfield, Korea, by Air Force C-119 Flying Boxcars. It was erected across the Han River by the 62nd Engineer Construction Battalion. It is interesting to note that the bridge equipment was transported by Marines from Kimpo to the river where the 62nd was supporting the 1st Marine Division. This was truly a joint effort.

Army aviation's concept of using light aircraft to support the ground operation passed through an important evolutionary phase in Korea. The helicopter came into its own as the war progressed and the use of fixed wing aircraft by engineers became more common than it had been in World War II.

A C-47, the versatile workhorse of World War II, lands on a Chinese airfield in 1944. Army Air Forces P-40 fighter planes are in the foreground

While three L-5 aircraft were available to my engineers for the Burma Road mission, this was the exception rather than the rule. In Korea, however, Army aviation assigned light aircraft such as the L-5 and later L-19 in greater numbers to engineer groups whose construction and logistics missions were scattered throughout the Korean Peninsula.

Army aviation's contribution to the engineer mission is not restricted to wartime uses. Its peacetime application is equally important. Some outstanding examples are found in surveying and mapping projects by the Corps of Engineers throughout the world.

It was with the 30th Engineer Group (Topo Survey), now the 30th Engineer Battalion (Base Topo), in Alaska in the 1950s that aviation proved its value and emerged as a vital necessity to survey operations. Throughout some of the most rugged and desolate terrain on the North American continent, the 30th Engineer Group used fixed and rotary wing aircraft as part of the survey operations to accomplish a task that otherwise would have taken years longer to complete.

Again, across the Sahara Desert area surveys were carried to successful completion under most difficult conditions. Where others had failed to accomplish this work, the Army engineers and their aviation succeeded.

Currently, Army engineers are mapping in Iran, Ethiopia and Liberia. The Inter-American Geodetic Survey is engaged in a successful cooperative operation in most of the Central and South American countries to accomplish urgent work for the development of these nations and the southern hemisphere.

The Vietnam war displays the greatest advances of American airmobility ever seen. The rapid

rise of Army aviation centers around the helicopter, although light fixed wing aircraft continue to play an important integral part in air support.

The value of airmobility is the ability to move troops into combat, relocate small units during engagement, provide close-in fire support, reconnaissance and surveillance, and to resupply the troops. This involves large numbers of aircraft, which in turn require varied and extensive air landing facilities from small clearings for rotary wing aircraft to stabilized airstrips for fixed wing cargo aircraft. This is one of the primary combat support missions of the Army engineers in Vietnam.

U. S. Army divisions in Vietnam are more mobile and responsive than ever through the use of helicopters, primarily the UH-1. The most mobile with organic equipment is the highly successful 1st Cavalry Division (Airmobile), the first and only airmobile division. It has less than half the ground vehicles of an infantry division with about 350 additional aircraft replacing 1,500 ground vehicles.

In praising the 1st Cavalry Division (Airmobile), Major General Robert R. Williams, when Director of Army Aviation, said, "It has demonstrated ability to strike far and fast, cover large areas and fight in widely separated areas. It has also demonstrated its staying power through its capability to support units in contact with the enemy at distant locations for extended periods of time with its own organic means for air resupply."

The CH-47 Chinook, a troop and cargo transport cargo helicopter, unloads combat ready troops in training exercises at the U. S. Army Engineer Center at Ft Belvoir, Va

The task of supporting this highly mobile force falls primarily to the division's 8th Engineer Battalion. In addition to providing close engineer support to the combat elements, the two missions with which the battalion is most committed are roads and airlanding facilities. Both tasks contribute to the mobility of the division—air and ground mobility —and the degrees of engineer success is directly related to the very airmobility being supported.

One of the first tasks of the engineers is to provide landing zones for helicopters in assault battalions. Usually the only way into assault areas is by helicopters, and often small teams of engineers must descend by ladder from the helicopters to hack out initial clearings for further landings. Hand tools, explosives, and other essential engineer items also are brought in by helicopters. Light engineer equipment, such as the TD-340 tracked dozer and the 3414 front loader/backhoe, also are airlifted for extensive clearing of landing zones.

In addition to landing zones, the 8th Engineer Battalion has constructed airstrips for fixed wing aircraft throughout the division zone. Strips are provided at the base camps, brigade forward support elements, and as far forward as possible in support of the assault battalions.

Although engineer troops, equipment and materials are often moved overland to these sites, much of the engineer support must be airlifted in because of terrain restrictions or enemy activity. For airstrip construction, the heavier D6B dozers and Caterpillar 112 graders are used. These, too, are often airlifted.

Continued on page 30

At the U. S. Army Aviation School at Fort Rucker, Ala., it is recognized that television's unique capabilities should not obscure the fact that its main purpose is to teach. This philosophy is inherent in the development of instructional television programs at the USAAVNS

Major Robert D. Morgan and Mr. John Krickel

TV

NO LONGER can TV be regarded as a nice-to-have aid to the instructor, since it has clearly demonstrated its ability to convey certain subjects better, in less time, or cheaper than conventional means.

With a greatly increased training mission demanding the best learning experience in the shortest possible time, the use of television in instruction is growing rapidly at all major service schools. Since each school is developing individual approaches to meet its local requirements, this article is intended to explain the television philosophy of the United States Army Aviation School.

Studies in recent years have confirmed that mere exposure of students to television in the classroom does not guarantee their learning. A television system must have good quality equipment to operate, and this represents a large investment; but even television studios with elaborate equipment may consistently produce educationally ineffective programs. Television does have certain unique capabilities, but these should not obscure the fact that its main purpose in a school is to *teach*. For this reason, then, the

---

Mr. Krickel was TV Education Advisor, Director of Instruction, Ft Rucker, Ala., when this article was written.

MAJ Morgan is Chief, Film/ETV Division, Dept of School Support, Ft Rucker, Ala.

educational strategy employed in planning television programs that teach can and should be basically the same as the educational strategy employed in planning any other highly effective learning activity, such as programmed instruction, for example.

Recognizing this similarity, the United States Army Aviation School has developed an approach to instructional television which is based on careful planning of the content and method in terms of specified student outcomes. An integral part of this approach is a philosophy of what television is and what its relationship should be to our instruction. This philosophy influences both the format and the classroom use of our programs.

The professional, dynamic instructor performs a vital motivational role in the learning process and television does not replace him in the classroom. Rather, TV remains one of the instructor's tools for communicating more efficiently with his students. Programs are planned always to allow an introduction by the instructor and a discussion period afterward; often they consume only a few minutes of a period which also uses other media.

Our instruction makes maximum use of integrated visuals in media — including television — to replace instructor words wherever the visual will increase student learning at a savings in time. Thus, the visual assumes a sizable share of the instructor's information-giving function. Where it is used, the television program becomes an integral, necessary part of the carefully planned learning experience; omission of the television program would significantly reduce the efficiency of the presentation.

Our instruction is based on performance-stated objectives derived from the graduate's job in the field. Television must materially contribute to the accomplishment of specific performance objectives for a subject and this contribution is measured and validated by criterion testing.

The content of our classes is precisely organized within 50-minute periods. Subjects are repeated frequently, and instructors become very familiar with the organization of each period. A television program is integrated into the segment of the learning experience for which it was planned, and—after experimentation by the instructor—can be identified as a specific time in the class period. Each time the class is presented, the television program will be shown at this time.

Television *must* contribute some quality to the learning experience which cannot be conveyed as effectively by any of the other media available to the instructor to achieve the required levels of student learning, or it will not be used. The television program is designed to fill a specific need in the learning experience. Wherever possible the subject is presented in terms of the terminal job for which the student is training, with major emphasis on those visual aspects impossible to duplicate in the classroom environment. Television will not be used as a means of presenting an essentially verbal message which could be better presented "live" in the classroom with an instructor.

A learning situation which is developed for maximum effectiveness must follow the intended sequence in its actual presentation to be effective; therefore, detailed scripts are necessary for each television program. While we strive for a relaxed, natural tone in narration and for situations with which the student can identify to produce esthetically pleasing productions, the organization of a program is planned and produced

A class at USAAVNS receives instruction via television

T V

in terms of applied learning theory. In particular our programs make use of active student participation and reinforcement of "feedback" of student proficiency.

The initial allocation of personnel and equipment, and complexity of the subjects involved, limits production to 40-50 legitimate instructional programs per year as a return on a capital investment of $300,000 in facilities. For the obvious economics involved, subjects for television programs are chosen carefully to provide maximum savings in manpower and equipment, or materially improve effectiveness of student learning in critical subject areas. However, these savings can be realized only if the television programs actually teach. The effectiveness of a program is dependent not only on the creative nature of its production, but also on the validity of the educational planning which goes into it. Therefore, each television program is developed in terms of specific educational criteria as a means of producing predictable, measurable benefits.

The procedure and agencies involved in carrying an instructional television program from idea to finished product are outlined in USAAVNS Regulation 350-26. Of major importance to implementing the philosophy of television discussed above is the recognition of the necessity for three separate, but related, ingredients of an educationally effective television program.

First of these is the contribution of the subject-matter specialist, usually the instructor. This individual is highly competent in the technical details of a body of knowledge and thus assures accuracy of content of a particular program. However, in the case of most military instructors (and civilian college instructors as well), he is almost never knowledgeable in educational systems design or television production.

The second ingredient is provided by the television production specialists and writers, who are responsible for devising esthetically pleasing programs with high student attention-attraction. Like the instructor, they are highly capable specialists in a limited area, but of necessity can know little of the subject matter. Further, few are trained in or have time to devote to the design of the learning experience.

It is unfortunate that educational television at many schools depends only on these two ingredients. This explains the most common failures: programs which are merely televised counterparts of sterile classroom presentations of an instructor talking to his class, or technically "slick" productions which entertain without teaching. The United States Army Aviation School recognizes a third, necessary ingredient for effective instructional television: the contribution of an educator to define, analyze, and design the framework of the learning experience.

Our instructional television reflects the interaction of these three essential elements—subject matter, production, and educational design. Each one is indispensable. Roles of the instructor and television producer are generally understood, but the educational design which goes into each program is a relatively new concept. It is carried out by a specialist who is concerned with achieving maximum *learning* from television. Specifically he is responsible for developing the framework of the television learning experience into a document called the "Educational Criteria," which is used to plan, write, produce, use and evaluate each program.

These educational criteria are prepared as the first step for each television project by the education specialist working with the instructor, and are concerned initially only with the learning tasks, not the television format. They are the result of an analysis of the subject block as a whole and an assessment of student background, immediate and terminal needs.

These criteria serve several purposes. First, they clarify and define the exact content of the program for the instructor and the outcomes which can be expected as a result of the tape. They objectively focus attention on the learning to be accomplished rather than the production treatment of the subject. For writers and other production personnel who base their scripts and production planning on the educational criteria, they give an exact description of the job to be accomplished, the elements to emphasize, the attitudes to be enhanced, and the examination questions against which their production must be measured. Later, the criteria provide a basis for judging how well the script and finished program meet the objectives, and for recommending revisions. And finally, they offer a means of objectively evaluating the effectiveness of the television program under classroom conditions.

For a typical television program, the educational criteria include seven elements:

• *Scope:* This is a list of the teaching points to be included in the program, and the proposed length, based on a careful evaluation of the total subject as well as the individual hour. It prevents

extraneous material from being introduced into a production and gives a definite length to aim for.

• *Student background:* It is important to know exactly how much experience the audience has had in the subject. This statement defines student background in terms of previous courses and the phase of the present course under study. Where applicable, an analysis is made of the students' level of practical experience. Student background provides one of the guides to writers and producers on the amount of repetition required in a program, the number of words which must be spelled out in addition to being spoken, and the necessity for "big-picture" orienting scenes in a given production.

• *Terminal objectives:* Most television productions tend to serve short-range goals of student preparation for practical exercise or examination, but this statement identifies the ultimate field-assignment task for which the student is being prepared. It serves to suggest the setting in which the program will be laid to lend realism and provide audience identification.

• *Planned use in instruction:* This criterion specifies the best location of the television tape within the hour of instruction. It states the specific information which will be taught before showing the tape, to serve as a guide to the writer in preparing his material and to the instructor in preparing his students for viewing the program. It indicates whether the tape is to be followed by a practical exercise in which students actually perform the skill, or if the television tape represents the terminal learning experience.

• *Attitudes to be enhanced:* Television has a strong motivational effect on students. Improper behavior on the job has frequently been blamed on attitudes acquired during training. Each tape is expected to reinforce certain desirable attitudes in addition to teaching factual information.

Cameramen prepare to televise a course at USAAVNS

• *Performance-stated objectives:* These are the heart of the educational design of the learning experience. In format these performance objectives are like those used for programmed instruction and all conventional instruction at USAAVNS. However, they apply here only to those exact, measurable student behaviors which can be reasonably expected as a result of viewing the television program.

The writer and producer know exactly the quantity of information and the degree of learning which must be reached; the instructor has a clear idea of how much return he can expect from the program. Further, they provide an accurate basis for measuring the manpower and material resources saved as a result of using television to teach certain information as compared with the previous method.

• *Performance check:* This criterion provides not only a basis for objectively comparing the effectiveness of television to conventional instruction—which is inherent to the USAAVNS television philosophy—but it provides one of the most valuable guides to the writer in preparing his script.

Each script is evaluated and revised several times, if necessary, in terms of how well it teaches the information on which the students will be tested. Later the test is administered to a control group and an experimental group of actual students receiving the training as a means of validating the finished television program. If results warrant, the program is revised until students viewing it reach the desired level of proficiency.

In conclusion, then, the United States Army Aviation School bases its approach to television on a practical philosophy which demands maximum returns from the medium. Programs are the result of a joint effort by subject-matter specialists, television production specialists, and education specialists. All phases of planning and production are guided by educational criteria designed to ensure maximum learning effectiveness. This concept of instructional television is designed to fit our own needs, but the principles underlying it can benefit any military or civilian user of television in education.

IN THE BALANCE

For a fleeting second the copilot sees what appears to be several men moving into the woodline . . . let 'em have it!

CW2 Stanley Q. Coss

REBEL 41, this is Swift 6. Charlie has our lead element pinned down just west of the railroad track! From banana, down two. Bring your fire team in and see what you can do for us!"

This is just what our hero has been waiting for. His whole purpose in life (for the time being) is to do just what he is preparing to do: zap Charlie!

The excitement and exuberance this fire team leader must feel, whether he is a young lieutenant or an old captain, is common to all soldiers. A man grows up playing at war. His childhood is filled with miniature conquests.

Our hero is such a man; young, intelligent, and an outstanding leader for his experience level. He is well prepared to carry out this mission. Especially today he is mentally prepared for the "kill," for this is his first month of combat; and thus far his chargers have been tethered to the post on standby, snorting and pawing the earth with impatience.

He has visions of the pomp and pageantry, of the awards ceremony as he kneels before the CO, with the broadsword on his shoulder, and receives his knighthood —or would you believe—a DFC! Yes! This is what our hero sees, that shiny bronze cross with the red, white, and blue ribbon pinned on his chest!

What our hero does not see, through the misty gloom, is three young widows receiving grave flags and Purple Hearts for their fallen husbands who died valiantly in close combat with the VC, and . . . yes, an armed helicopter. For at this very minute the fire team leader is coordinating the doomed mission with the ground element.

The Infantry company commander is on the group beside his vehicle, looking across 150 meters of open ground to the railroad track which runs parallel to the road his company is clearing. His situation is bad, for the VC have devised a deadly ambush in expectation of the large resupply convoy which is moving north to the Special Forces compound. If the road clearing bogs down here, the coming nightfall will surely bring annihilation to the convoy. The CO has lost commo with his right flank platoon. The RTO (radio-telephone operator) was undoubtedly the first target of a sniper. His PRC-25 was probably damaged.

The right flank platoon leader is another of our young heros. Upon receiving fire he sent a squad to outmaneuver the insurgents. He is preparing to send a report to the CO by runner, but heavy fire prevents the runner from crossing the open ground to the CO's position.

To make a bad situation worse, the CO is inexperienced in combat, and has never used the support of gunships before this engagement. His agony at visualizing his company picked to pieces here beside this road prompted him to action. He could see from where he lay that the right flank platoon had taken up positions along the railroad embankment, a natural cover. He was not aware that the second squad had crossed the embankment in search of the snipers.

Explosions started erupting within his perimeter. Was it a mortar attack? Probably 60 mm, or rifle grenades, from the size of the burst. His mind became frenzied!

"Rebel 41, this is Swift! Are you on station?"

"Roger, Swift. What is the situation?"

"This is Swift. We are under small arms and mortar attack from east of the railroad embankment. Make a run and see if you can relieve the pressure here!"

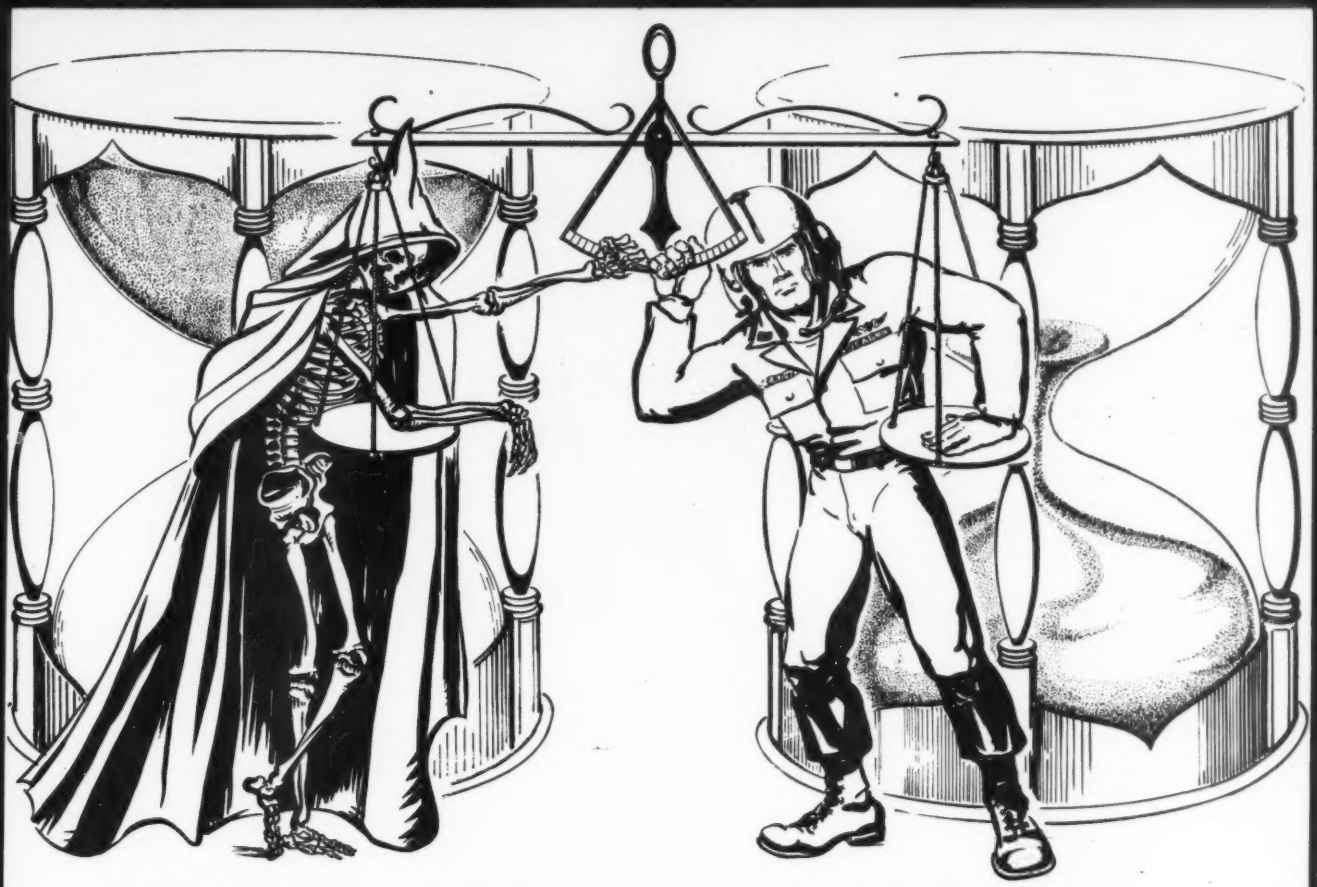
"Roger, Swift. What is the limit of your eastern flank?"

"All our troops are west of the railroad. I say again, west of the railroad."

Here our story is about to paint a vivid picture for you—the man who might be making the decisions in the future, for the decisions of the past are done. Some of them were good decisions. Some were bad.

What will our young hero do? He has no time to dally along looking for the target. He must lay down a deadly blanket of suppressive fire to enable the ground troops to maneuver to a more favorable position, or perhaps he can neutralize the VC.

CW2 Coss is assigned to the Employment Division, Dept of Tactics, Ft Rucker, Ala.



The plank (his actions and orders) lies across the fulcrum. On one end of the plank are three caskets; on the other end, pride in a mission well done. His decision will be placed on the plank—on one end or the other. The fate of this squad of GIs lies in the balance.

Let those of us who have been in the combat zone recall some similar experience. The general idea can be applied to any number of circumstances. Pretend, if you will, that you are Lieutenant Hero, fire team leader on the spot! What will you do now, my friend? The situation is bad, and could get worse. You are the great equalizer, or can be, in this epic story of ours.

Let us consider the following:

Course of Action Alpha

The fire team is now orbiting the area above the pinned down company. Lieutenant Hero sees the bursts of mortar rounds and is sobered by the call from his wingman.

"Rebel 41; 42 receiving fire!"

Not only is the ground unit in need of immediate action, but now his own fire team is being jeopardized by ground fire.

For a fleeting second, Lieutenant Hero's copilot sees what appears to be several men moving into the woodline.

"There they are, about 50 meters east of the tracks."

"Swift, this is 41. We are going to make a pass from north to south."

"Roger, 41. Let 'em have it!"

You know the rest of the story. It has been aptly stated that "haste makes waste." Lieutenant Hero's fire team struck a devastating blow that misty afternoon. Only minutes later, after the runner finally got to the CO, did Lieutenant Hero know. . . .

"Rebel, this is Swift. Cease fire! Cease fire!"

Course of Action Bravo

The fire team is now orbiting the area above the pinned down company.

"Swift, this is Rebel 41. We have spotted some movement in the treeline. Mark your easternmost position with smoke."

Say now! This Lieutenant Hero is really "on the stick"!

"Roger, Rebel; wait!"

The CO now gets into the action and sends a runner (low crawling) to the besieged platoon leader's position with the message. The message is yelled across the 50 meters to the second squad in the trees.

Just as the fire team rolls in for its gun run, red smoke drifts up from the second squad's position. Wouldn't you know it! Just where the CO said to suppress!

The key to freedom

Military Leadership

Sergeant Major Glenn E. Owens

THE ART OF influencing and directing men in such a way as to obtain their willing obedience, confidence, respect, and loyal cooperation to accomplish the mission — this is military leadership.

Today throughout the world, men in Army aviation are setting a shining example of leadership. Regardless of whether you are in an aviation, armor, artillery, or infantry unit, as a leader you are playing the most important role of your life.

The first concern of the noncommissioned officer, and especially of the sergeant major, is for his mission and his men. If he fails in that, he fails in everything and becomes nothing more than a travesty of uniform.

The noncommissioned officer gets to know his men as soon as he possibly can. He knows their capabilities and individual limitations, their temperaments, even the outside worries that hinder their work. When he can he helps solve these outside problems by advice, by investigation, or through welfare agencies.

He is vitally concerned with the continued high morale of his men. Because all factors of life affect morale, his interests concern their sleeping arrangements under all conditions of garrison or campaign, their food, their health, their recreation, their punishment, their rewards, and their training.

The noncommissioned officer is concerned that they do not die in combat through their own ignorance — or his ignorance or carelessness in failing to instruct them adequately and continually. For only through training can he lead them intelligently in all conditions of combat that may arise.

A dead soldier who has given his life because of the failure of his noncommissioned officer is a dreadful sight and a crime before God. Like all dead soldiers, he was tired before he died, hungry undoubtedly, dirty, wet, and possibly frightened to his soul. And there he lies — never again to see his country and home.

Don't be the noncommissioned officer who failed to instruct him properly, who failed to lead him well. Burn the midnight oil, Sergeant, that in later years you may not look at your hands and find his blood still red upon them!

Now then, as a part of your contract with the government and the entire people of the United States — and perhaps as a compensation for this deep, all-pervading obligation to his own men — the noncommissioned officer has certain privileges.

If you will examine those privileges, you will see that they are given for well-defined reasons

---

SGM Owens is the U. S. Army Aviation School Sergeant Major, Ft Rucker, Ala.

— to free the NCO from certain details of his own living, to isolate him to a small degree for thought and study, and to erect around him a modest individual niche and a low pedestal from which to exercise the dignity of his function to command.

Where does this noncommissioned officer of today come from?

In comparatively small quantities he still comes from civilian colleges and high schools all over the country, where a less confining and less thorough 4 years' work has given him a barely adequate grounding in the fundamentals of his job. He comes from grade school, and his Army background may be anything from enlistee long-service to a short-service selectee. He has all variety of education, from merely high school to through college to two or more degrees—and all variety of previous jobs. His age is from 18 to 55 for service with combat troops, but his average age is about 26.

He has, however, one thing in common when he serves with combat troops. He will lead those troops, in some cases, personally into action, and on his shoulders will rest the fate of the nation! And he will be successful in serving the future of the United States only insofar as he is successful in securing the present welfare, in all things, of his men.

No other job is left for him — no excuse can be offered for not doing this job. On 7 December 1941 when the first Japanese bomb hit Hickam Field, the past, the present, and the future of the United States stood still — just as if a film had stopped in a projector. The worth of the past lay solely in how much it could inspire, influence, and activate men to face the daily, soul-searing grind of the present — on all fronts. Those men faced it and forced it to final hard-won victory. Today in Vietnam some of those same men are the NCOs who lead a new Army to fight that a new future might unfold again: Freedom throughout the world.

And that, Sergeant, is the story.

That insignia you wear on your sleeves is a part of the government and the destiny of the United States. It is not yours personally for any grace that is in you; it is a symbol of the militant people, the fighting government of your country. It implies a special trust and confidence in the patriotism, valor, fidelity, and abilities that are in you.

The stripes of your sergeant first class and your sergeants, the bars of your captain, and the stars of your general are also an integral part of the militant people and the fighting government of this country — all graduated plainly in terms of responsibilities, accountabilities, and command functions of the ageless military hierarchies of armies.

Look at your rank a moment as you peel off your shirt tonight. You're tired and maybe you can think of a hundred places you'd rather be. You have private worries — a wife, a girl, homesickness, a younger brother who needs your guiding hand, a frightened old mother. You are fed up with the stupidities you have had to contend with today. You'll be double-tied if you'll keep on training men and then have them cadred away from you or sent to officers candidate school or warrant officers candidate school. (You young fool, you'll still be training in the midst of combat, and this kind of expanding Army where you lose your best men continually is the best training for combat, where all men are expendable.) And everyone else gets promoted but you.

All right — look at the rank again, Sergeant Major or Sergeant, look at it in the light of your blacked-out flashlight or your desk lamp in quarters. There it is still, like the Hound of Heaven. You can't escape! A part of the fighting government of the United States — and it's on your shirt. So take a relaxing drink if you think you need it — but not the 20 that will put you on the road to town, staggering before your men — sit down and think of your responsibilities to your men. Have you given them that added something that is required of a military man? Are you prepared for tomorrow, for next week, for combat? Will some of them die because you are not adequately equipped to lead them?

Reach then to your bookshelf with the young hand that is still clean of their blood and take down that field manual for a few brief moments before you sleep, because you won't be a sergeant forever — not in this Army. Next month, next spring, you'll be a sergeant major, lieutenant, warrant officer, or maybe captain. And before the last shot is fired, you may be throwing armies around.

But you won't be any of it or do any of it unless you fortify your professional knowledge and your inner spirit now and always against the dark night when your decisions will be right or wrong in terms of hot red blood — unless you spread your knowledge everywhere you go, so that those who are privates and corporals and sergeants under you today may be tomorrow's officers.

Whether you face your job now, while there is yet time, or whether you scotch it; whether you realize the worth of this advice or dismiss it as the old malarkey, remember just one thing:

Prepared or not, worthy or not, competent or not, when the time comes, "This platoon or squad will . . ."

— and for better or for worse before the inexorable gods of battle, you'll lead it, Sergeant.

17th Combat Aviation Group

Captain Barry J. Nelson

THE 17TH COMBAT Aviation Group is a tactical combat command. It owns "line" companies which routinely face and trade fire with the enemy. It commits and deploys those units on mission-type orders from higher tactical headquarters, and it helps plan the operations that will involve its units, passing down its decisions as five-paragraph field orders. A combat command operating in both I and II Corps areas of South Vietnam since 1 March 1966, the 17th CAG does all those things.

It is a busy command. All of its commanders have been Army aviators, charged with providing airmobility — the transport to victory — for the two brigades and three divisions of United States and Korean infantry that, in combination with the 17th CAG and the 1st Cavalry Division, form the I Field Force Vietnam starting lineup. While its main mission is to make airmobile these combat troop units under I FFORCEV direction, 17th CAG also renders visual reconnaissance and armed helicopter support to ground units under enemy contact.

That it does this from a fixed headquarters in Nha Trang, hundreds

A Huey arrives with troops before an assault in Vietnam

of miles from many of its battle areas, stems from a need to be near the master planning command in II Corps — I FFORCEV — and detracts nothing from its ability to react to the tactical situation. Its far-flung communications network, coupled with a modest stable of command control aircraft, enables the commander and staff to be instantly informed and rapidly on the scene if needed.

An example of this is the 17th CAG commander who personally flew combat assaults in Phan Thiet in the morning and in Kontum in the afternoon and on the same day reviewed plans with commanders of the 4th Division and the 101st in command posts 250 miles apart.

Aviation-minded 17th Group units make combat assaults with any friendly force that really needs help. Its air armada of choppers is sent to battle in each of the republic's four corps zones to support nearly everyone but the enemy.

In the command post of the 17th CAG commander stands an impressively varnished tree stump, 4 feet high. Fastened on its bare, gleaming surface are metal plates naming major combat operations fought in Vietnam since February 1966. The combined names form a total picture of the war as waged by I FFORCEV.

Tacked to the campaign tree are plates engraved with names like "Attleboro" and "Junction City," operations conducted by I Field Force Vietnam in the III Corps tactical zone outside the 17th's normal operational area. There are plates labeling operations conducted by the 5th Special Forces Group and other operations which, except for aviation support, were strictly ARVN affairs. They represent jobs the group has handled for other bosses, like COMUSMACV and the corps senior advisor.

Even the plate-bedecked stump fails to tell the whole story; some 17th CAG units receive their orders through yet other channels. Their exploits support the overall war effort involving the massive 17th in combat from the delta to the DMZ, adding to its total list of major operations.

Two 17th CAG Mohawk surveillance airplane companies track enemy movement and report them to higher headquarters. Bird Dog pilots supporting I FFORCEV, the 3d Marine Amphibious Force, and the RVN Army blanket the northern two corps areas with visual reconnaissance. They aim air strikes, armed helicopters, artillery, Navy batteries, and their own rocket fire at the enemy in support of ground combat. Meanwhile, a 17th CAG assault helicopter company, supporting the 5th Special Forces Group, flies the Green Berets to work in the northern half of South Vietnam.

Few tactical commands short of MACV are so widely committed. Group output figures suggest the size of the load it carries. In the period from its inception on 1 March 1966 to the end of June 1967, the 17th CAG amassed nearly 650,000 flying hours (that would take one aircraft nearly 75 years) and carried one and a half million passengers. Thirty-three planes hauling an average of five passengers apiece would have to stay airborne all year, nonstop, to equal it; and they'd have moved every American in Vietnam three times.

That, of course, isn't how it is done. To pick up and deliver their passengers — mostly infantry troops on combat missions — crewmen often had to suppress or try to ignore the fire of enemy small arms, machine-gun, and antiaircraft weapons. Much of their flight time was accumulated in the anxiety of overloaded ships at outlandish density altitudes, or at night, or in miserable weather, or in all three. They were combat hours fought and died in by a breed of soldier whose debut in close combat has emblazoned his name in the annals of battlefield audacity — the Army aviator.

The 17th CAG has more than 1,100 of them in five battalions scattered over 65 percent of the land mass of South Vietnam. It has over 6,000 other members who aren't pilots, but nearly half are flight crewmen. The rest form a supporting base of mechanics, POL specialists, pathfinders, security forces, clerks, cooks and medics who in various ways helps to keep the Group's close to 600 birds flying. The Group is still growing; two more battalions are in the process of being formed.

It is an aviation command on a scale unknown to the Army just a few years ago — a child of necessity, sired by the massive buildup of American infantry in Vietnam and born by the desire to make our combat forces there airmobile.

While helicopter operations and aerial reconnaissance were proving their worth to Vietnamese troops in combat, the U. S. Army in 1963-64 was testing the practicality of massive heliborne assaults through its experimental Air Assault Division. Something new to the Army — an aviation group, owning several battalions — gave that division its wings, while in Vietnam the structure of non-divisional aviation was proceeding in the same direction.

By April 1965 the mounting number of aviation platoons and companies in the war zone had been

---

CPT Nelson, former 17th CAG Information Officer, is currently assigned to HQ, 16th U. S. Army Corps, Omaha, Neb.

17th CAG support has included Korean troops. Above, a Huey brings supplies to the ROK Tiger Division

grouped into battalions for control. That month a new non-divisional aviation group headquarters was scratched together from existing assets in Vietnam and offered to the Department of the Army as the USA Aviation Group (Provisional). Its boss, COL Raymond G. Jones, assumed command of five aviation battalions, a company and a section sprawled over the entire republic and was asked to provide helicopters and airplanes to everybody there who hadn't brought his own. Most hadn't.

The arrival, in mid-summer, of the 173d Airborne Brigade, the 1st Infantry Division and the 1st Brigade, 101st Airborne Division placed additional demands on existing aircraft and gave the fledgling group an even larger workload. Several more non-divisional airmobile companies were being groomed at Fort Benning, Ga., to relieve the flying burden on helicopter units already in the theater. However, their arrival would hardly ease the command burden on their controlling headquarters.

In August 1965 the provisional group was renamed the 12th Aviation Group with the arrival of an officially constituted headquarters element from the States. A second aviation group came in September when the old Air Assault Division offloaded at Qui Nhon as the 1st Cavalry Division (Airmobile). This group, the 11th, had few plans for its aircraft beyond supporting the division, and the nagging need to keep other ground forces flying was pumping chopper units into the 12th Group beyond its capacity to manage them.

Army combat operations were about to be divided between two corps-type headquarters called I and II Field Force Vietnam, and it was decided that each should have an aviation group on its "first string" of operationally controlled units. Out of that decision came a U. S. Army Pacific General Order, dated 9 December 1965, activating Headquarters and Headquarters Company, 17th Aviation Group.

The new unit now needed people and aircraft. Its first commander, COL Gerald Shea, was reassigned from a job as USARV aviation officer on 1 January 1966. Most of the rest of the group's lean assets were pulled from the overladen 12th Group.

The new headquarters, codenamed "Eagle," settled in Nha Trang on 15 January to collocate with I FFORCEV. There it further staffed and prepared itself until, with a minimum of men and equipment, Colonel Shea proclaimed his shop ready to open. On 1 March he was handed the reins of the 12th Group's northern three battalions. When COL John W. Marr became the 17th CAG's second commander on 4 June, he was taking charge of a major combat command.

Under Colonel Marr the group structure showed its largest growth,

expanding to five combat aviation battalions with more than 7,000 personnel, and over 500 helicopters and fixed wing aircraft deploying from countless new airfields throughout the I and II Corps tactical zones of South Vietnam. Now the next year, under COL Bill G. Smith, who assumed 17th CAG command on 29 May 1967, should bring even more growth.

A combat command. A tactical, fighting unit. Applied to the 17th Aviation Group, those terms have been difficult for some nonaviators to accept. This is particularly true of those who haven't ridden to battle in a low-level chopper formation; or been forced to cover by a torrent of enemy lead and had the pressure relieved by a gunship's rapid, sure-aimed firepower; or been pulled from a hopelessly surrounded position by a chopper crew whose ship was being raked by gunfire on the approach but kept on coming.

But, for all that, Army aviation is still considered only a supporting force. And, of course, it is a supporting force in the sense that its worth hangs on what it can do for the infantrymen, but its value to him in Vietnam is comparable to armor's relationship to infantrymen in the European theater during WW II. Army aviation is firepower, mobility, and even shock effect. As did tanks, its gunships offer the riflemen covering and assault fire from a mobile platform. More effectively than armored personnel carriers, its machine-gun-toting slicks speed the troops across uncontested ground to terrain they must occupy.

The similarities stop there. In the end there is no comparison, no precedent for the work of Army aviation in Vietnam, no description more telling than the words of grateful ground commanders.

For their operations are 17th Group operations. Their units carry most of the acclaim for success like "Hawthorne" and "Paul Revere" and "Junction City" and "Task Force Oregon," but the battles were won by airmobile combat teams to which the 17th CAG contributed the airmobility.

Lieutenant General Stanley Larsen, former CG, I Field Force Vietnam, said in an interview in February this year: "The helicopter was developed at a time when we absolutely had to have it, and the men who fly it are nothing but courageous. Most infantrymen think the average Army pilot sticks his neck out more often than they themselves do. To me, infantry, artillery, armor, and Army aviation should be said in the same breath, along with signal and engineers, of course, because as far as I'm concerned it's a combat arm. We couldn't be winning here without it — or perhaps even holding our own."

MG Stanley R. Larsen (left) and BG Willard Pearson (center) have had high praise for the 17th CAG. Here they confer with LTC J. B. Rogers during operation Harrison

Brigadier General Willard Pearson, CG, 1st Brigade, 101st Airborne Division, wrote to 17th CAG commander, Colonel Shea, in March 1966: "I feel the tremendous contribution of your units is best summed up by the remarks of one of my battalion commanders, who described the performance of the individual pilot as 'magnificent.' We on the ground salute him for his valor. The chopper pilot is a new breed of soldier . . . and we are proud of him and welcome him as an essential partner in the combined arms team, to whom falls the ultimate task of closing with the enemy and destroying him."

Colonel John Austin, CO, 1st Brigade, 4th Infantry Division, in a letter to the Group's 10th Combat Aviation Battalion last January, said: "We are highly mobile — but you are our mobility. . . . You have been food for hungry men, munitions for vital weapons, water for dry throats, and mail from home. Your gunships are the arm that can hit at the far distance. To us you are not a supporting force but a part of the total force. We are winning on the battlefield because of you."

"We are winning . . . because of you." A brief remark, but it leaves little unsaid. This winning war effort in Vietnam comes from just such "supporting" contributions as those made to I Field Force Vietnam by the 17th Combat Aviation Group.

AIRMOBILE ENGINEERS

The equipment worked throughout the night under lights. This did not make the 8th Engineer Battalion extremely popular with the Marines who had been experiencing nightly sniper and mortar fire

Captain Gene A. Schneebeck and Captain Richard E. Wolfgram

AS THE INFANTRY jumps into a new battle area in an isolated portion of Vietnam, it is only a matter of time before they must be followed by a logistical complex consistent with the size and momentum of the battle action. During the first part of April 1967, the 1st Cavalry Division (Airmobile) was called upon to assume a portion of the I Corps (Marine) sector in southern Quang Ngai Province.

Because of the tempo of the 1st Air Cavalry Division's operation and resulting tonnage of logistical supplies required, it was necessary to immediately develop a logistical complex for supporting this operation. The overall plan included construction of an airfield at Duc Pho, starting with an USAF C7A (Caribou) strip and eventually increasing it to a C-130 airfield, as well as construction of a simple port facility on the South China Sea coast and a land line of communications (LOC) connecting the two by selecting the route and constructing 6 kilometers of road through the rice paddies between them.

1st Cav Responsibility

Long before any operation was envisioned, the Duc Pho area had been viewed as a potential airfield site by the 8th Engineer Battalion's commander and consequently had been reconnoitered by a composite intelligence/operations team early in March 1967. At this time a centerline azimuth was selected, a general estimate of earthwork calculated, and decisions on equipment required for construction made. Since the Duc Pho area was outside the 1st Air Cavalry Division's area of operations at that time, the plans were filed away.

CPTs Schneebeck and Wolfgram are currently serving in Vietnam with the 1st Cavalry Division (Airmobile).

In the early morning hours on 7 April 1967, the 1st Air Cavalry Division was ordered to move a brigade into the Duc Pho area. The 8th Engineer Battalion located at English Airfield was simultaneously ordered to construct a C7A battle area airfield within one day in the Duc Pho area and extend it to a C-123 capable airfield in two more days. A plan to open a sea LOC was also required. The reconnaissance report on the Duc Pho airfield was immediately reviewed and by dawn that morning plans for the move were in final form.

Dusseau Airfield

The mission to construct the airfield was given to Headquarters and Headquarters Company and a squad from Company A was attached for pioneer engineer support. The remainder of the night was spent preparing the construction equipment of the First and Second Equipment Platoons for airlift. At this time, both Companies A and B had one D6B committed in the forward area. These dozers were also readied for airlift from their respective locations north and east of English Airfield.

Late in the morning of April 7th, the battalion was directed to begin its move. A survey team was airlifted by a UH-1D to Duc Pho and began laying out what was to rapidly become Dusseau Airfield. At noon the airlift of Headquarters and Headquarters Company began, and by midafternoon one TD-340 bulldozer, two D6B bulldozers, two CAT 112 graders, one Martin scraper (grader bowl), one vibrapactor, two 3/4-ton dump trucks, and two 1/4-ton trucks had been airlifted by eight CH-54 Flying Crane and nine CH-47 Chinook sorties to Duc Pho and assembled. The availability of aircraft was limited because of the simultaneous airlift of 155 mm and 105 mm artillery batteries, and all the equipment scheduled to be moved could not reach Duc Pho the first day.

By evening, the airfield was completely staked out on a magnetic azimuth of 19°, and the two D6Bs and two graders began stripping the 18 inches of loose, silty overburden from the runway. The TD-340 tracked dozer and 3414 front loader/backhoe were put to work digging hasty protective positions in the company bivouac area. The equipment worked throughout the night under the lights of vehicles and a floodlight set. This did not make the 8th Engineer Battalion extremely popular with the Marines, who had experienced nightly sniper and mortar fire for the preceding three months. However, the only thing that disturbed their sleep that night was the rumble of the equipment.

By dawn the Caribou runway of Dusseau Airfield was 50 percent complete. The equipment crews were rotated and work continued throughout the day. Additional engineer equipment was airlifted to Duc Pho from English Airfield. One D6B bulldozer, three MRS-100 tractors, two 8 cubic yard pans, two CAT 112 graders, one Martin scraper, one double-drum sheepsfoot roller, one self-propelled pneumatic roller, and a contact maintenance truck were moved by sixteen CH-54 and five CH-47 sorties, assembled, and placed in operation.

After 24 hours spent moving 7,000 cubic yards of earth, the 1,400-foot compacted earth C7A airfield was completed. Work again continued throughout the night to lengthen Dusseau Airfield for C-123s. By the time the USAF inspection team had declared the C7A strip operational, the entire 2,500 feet of the C-123 runway had been stripped of overburden, and when the first C7A landed at noon on April 9th, the runway was 1,800 feet long.

That day C7As began delivering 36-inch CMP culvert, and the squad from Company A began working around the clock assembling a 165-foot length to carry a major drainage channel under the airfield. The heavy equipment continued cut, fill, and compaction operations even though hampered by heavy aircraft traffic.

By evening of April 10th, all that remained to complete the airstrip was installation of the culvert. The two 3414s cut a trench through the drainage channel while the squad completed the culvert assembly. Because the drop from the culvert invert to outlet was only 0.3 feet, the culvert bed was carefully prepared by hand under the watchful eyes of a survey team working by flashlight. Two D6Bs slowly moved the culvert into position and care-

A CH-54 lifts a 3414 front loader/backhoe, to Dusseau Airfield in Vietnam

fully pushed it into the trench. The culvert was backfilled and compacted, and by dawn the 2,500-foot long by 50-foot wide compacted earth surface C-123 runway was completed.

Within a 72-hour period 25,300 cubic yards of earth had been moved by helicopter transportable equipment. Shaping and compaction operations continued to improve the runway throughout the day, and a USAF inspection team declared Dusseau Airfield a Type I C-123 strip. The airfield met all the criteria of a Type II C-123 strip; however, a barrier fence at the north end, which could not be moved immediately because of a local village, restricted the glide angle and only 2,000 feet of the airfield could be used.

Above, a CH-54 carefully aligns the rear half of a grader for easy assembly with the front. Left, graders shape the airstrip at Dusseau Airfield only hours before the first aircraft lands (lower left)

On the following day, a parking area for three aircraft was constructed adjacent to the west side of the runway. The area surrounding the airfield was landscaped and a 16-foot high control tower was airlifted 100 kilometers from Camp Radcliff at An Khe to Duc Pho by CH-47.

The Second Runway

To allow the 39th Engineer Battalion to lengthen Dusseau Airfield for C-130 use, a second C7A runway was required to allow continuous operation of fixed wing aircraft. On April 13th construction of this runway began. The edge of the strip was placed 145 feet west of the centerline of Dusseau Airfield so that it could

be used as a taxiway for the future C-130 airfield.

An additional squad from Company A was airlifted by CH-47 to Duc Pho, and both squads began relocating 1,000 meters of barrier that cut diagonally across the proposed runway. The fougasse and claymore mines were removed from between the two belts of triple standard fence and, with the aid of two D6Bs, the fence was removed. Construction of the new barrier progressed rapidly across the open terrain, and by nightfall it was complete.

Because there was no requirement for exceptionally rapid construction of this airstrip, work progressed only during daylight hours. By the evening of April 15th, after 24 working hours were spent moving 7,000 cubic yards of earth in stripping, cut, and fill operations, the runway was complete. The following morning the two runways were connected by a taxiway at the south end and by extending the parking ramp on the north end. That afternoon a C7A landed on the new runway, and Headquarters and Headquarters Company prepared for airlift back to English.

Brigade Engineer Activity

By April 9th, Company (–) had moved by air to Duc Pho to provide support to the 2d Brigade, 1st Air Cavalry Division which had deployed for Operation LeJeune. Nine CH-47 sorties were required to move six 3/4-ton dump trucks, three 1/4-ton trucks, and personnel. Immediately, one platoon was deployed in support of the 1st Battalion, 5th Cavalry which was conducting search and destroy operations in the hills southeast of Duc Pho. This platoon supported the infantry by sending minesweep teams along with the elements searching the Viet Cong dominated territory. Numerous cave complexes and tunnels used by the enemy were located and destroyed by the platoon's demolition teams.

At LZ Montezuma, the brigade base and site of Dusseau Airfield, Company B engaged in numerous general support tasks. The fine soil of the area presented an extensive problem to the helicopters of the division, not only as a safety hazard because of the limited visibility but also because the angular soil particles rapidly erode helicopter engine turbine blades. Three asphalt distributors, an Anthony crane, and a 2½-ton dump truck were flown to Duc Pho by two CH-47 and four CH-54 sorties and 38,000 gallons of asphaltic dust palliative were placed on helicopter parking, sling out, and refueling areas in a 10 day period.

Other general support tasks undertaken by Company B were the construction of helicopter revetments for aircraft that remained at Duc Pho during the night, the construction of 150 meters of pioneer road at the top of Hill 150 using hand tools and demolitions, the installation of 5,500 meters of triple standard concertina barrier, and the construction of a 30-foot timber bridge as a civic action project.

One of the 8th Engineer Battalion's airmobile water points had been airlifted to Duc Pho on April 8th. Because the only suitable source of water was in insecure territory, Company B conducted a minesweep along 500 meters of road to its site every morning. During one 3 day period, a 250-pound bomb with an 82 mm mortar round booster, three 105 mm rounds, one 155 mm round, one 106 mm beehive round, and two M18s (claymores) were found emplaced as mines along the short route to the water point site.

On April 16th the Second Equipment Platoon (–) of Headquarters and Headquarters Company was attached to Company B to execute portions of the base development plan for LZ Montezuma. This plan had been devised by the 8th Engineer Battalion in conjunction with the 2d Brigade and the Division Support Command. The two D6Bs and two CAT 112 graders remaining at Duc Pho constructed a two lane road encircling the airfield and improved existing roads within the base complex. The next day the equipment was placed in support of the 39th Engineer Battalion and pioneered the opening of 2 kilometers of the road linking Duc Pho with the South China Sea.

On April 19th, Company B was airlifted from Duc Pho to LZ Uplift, between Bong Son and Qui Nhon, thus terminating its role in Operation LeJeune. The Second Equipment Platoon (–) remained at Duc Pho to assist the 39th Engineer Battalion until April 25th, when its remaining elements were airlifted to English Airfield.

Conclusion

During the period the 8th Engineer Battalion was employed at Duc Pho, the 39th Engineer Battalion landed on the coast of the South China Sea and after a joint reconnaissance with the 8th Engineer Battalion, began construction of a road inland to Duc Pho. By the time the airmobile engineers had completed their tasks, the 39th Engineer Battalion was moving their engineer equipment overland to continue the engineer effort.

In this respect, Operation LeJeune was a classic example of the widely known, but seldom practiced, concept which calls for the employment of airmobile engineers to an otherwise inaccessible location to accomplish a mission and their subsequent relief by conventional engineer elements as soon as possible.

THE IMPROVED CHINOOK

Truxtun R. Baldwin

THE U. S. ARMY CH-47 Chinook helicopter is undergoing a redesign and requalification program aimed at achieving its full potential as a medium transport helicopter. A number of structural, aerodynamic, and installed power improvements are being incorporated which will enable the Chinook to take advantage of its inherent greater productivity through increased speed and payload. The program gives recognition to the helicopter's new tactical role in the Army's airmobile concept and is keyed to new operational requirements which have resulted from combat operations of units employing this new concept.

The Chinook was first deployed to the Republic of Vietnam with the 1st Cavalry Division (Airmobile) in September 1965. In 22 months since initial deployment, Chinook units have flown over 88,000 hours and 238,000 sorties, averaging more than 44 flight hours per month per helicopter. Over 1,350 downed aircraft have been evacuated by Chinooks. They have transported over 610,000 tons of cargo and 671,000 passengers in RVN.

Exposure that has seen accomplishment has also uncovered areas which could be improved. In December 1965 the 1st Cavalry Division submitted an urgent request for increased military payload and airspeed capability. The request was prompted by effects of the Southeast Asian environment on performance of the helicopter. In moving from the relatively favorable United States ambient conditions, where the air assault exercises took place, to the severe high temperature and high density altitude conditions of the South Vietnam plateau region, the Chinook gross weight to hover became materially less and airspeed was reduced.

A further reduction in payload resulted from the necessity to carry over 2,200 pounds of combat equipment, made up of suppressive fire weapons, .30 cal. dynamic component armor, pilot and copilot seat armor, an additional crewmember, armor vests and miscellaneous rescue and survival gear. Where loads of 10,000 to 11,000 pounds were com-

When he wrote this article Mr. Baldwin was a Technical Director in the Office of the Chinook Project Manager.

monplace in the air assault exercises, in its new environment fully configured for combat, the Chinook was able to carry 7,000 to 8,000 pounds and then at an airspeed of only 95 knots.

Need for increased RVN capability was confirmed by USARV in November 1966, identifying the requirement for carrying a complete howitzer gun section in tactical operations, which was twice the available payload, to enhance resupply of forward elements. The Chinook has the unique capability of being able to transport the howitzer externally with the ammunition slung further below while the 7-man crew rides internally (left). One improved Chinook will be able to maintain the tactical integrity of this gun section, weighing 10,560 pounds, even under the most severe Army hot day conditions of 6,000 feet and 95° F.

The purpose of the Chinook improvement program, therefore, was to respond to the newly stated operational requirements as rapidly and economically as possible, minimizing the risk to a production program of 15 helicopters per month.

Aware of the new requirement, the Army Materiel Command conducted a technical feasibility study in February 1966. The study was conducted by the Research, Development and Engineering Directorate of the U. S. Army Aviation Materiel Command in conjunction with the U. S. Army Aviation Laboratories and the Air Force Aeronautical Systems Division. (The Army assumed prior Air Force engineering and procurement functions on the Chinook program in April 1966.) The study concluded that an improved Chinook helicopter was technically feasible and identified the areas of technical risk, intermediate milestones, and schedules necessary to assure the program's success.

Conforming with the technical feasibility study, AMC recommended a two-step approach under the regulatory authority of a product improvement program. Because the improved Chinook would be "providing real strides forward in terms of combat effectiveness" product improvement funding was deemed appropriate. The Department of Army approved initiating the program in May 1966, and AMC issued a letter contract to The Boeing Company, Vertol Division on 21 June 1966.

The first step in the program resulted in the CH-47B helicopter, which incorporates an aerodynamically improved "droop snoot" rotor blade and provides up to 45 percent greater speed under typical RVN conditions of 3,000 feet and 90° F. The B model also provides an increase in payload of 800 pounds. Parts of the rotor and control system have been strengthened to provide greater structural margins, therefore increased reliability and higher component service lives.

The first B model helicopter was delivered in mid-May 1967, at which point A model production ceased. The redesign of components has been undertaken to facilitate retrofit of the CH-47B model helicopters to the CH-47C model, step two, at a later date.

Step two in the improvement program, delivery of the CH-47C helicopter will begin in March 1968 and will feature an uprated transmission system to permit installing the uprated version of the Lycoming T55 engine. The new version, the T55-L-11, will be rated at 3,750 shp compared to 2,650 shp of the current T55-L-7. The qualification contract for the uprated engine was awarded to the Lycoming Division of AVCO Corporation on 1 March 1966. The increased power available will increase the Chinook's payload capability more than 100 percent and permit installing additional fuel cells which will double the helicopter's radius of action or double the number of sorties without refueling.

Figure 1 summarizes the performance of the three models on a 100 nautical mile mission at 3,000-feet, 90° F. conditions. The CH-47C becomes 2.7 times more productive than the current A model in terms of speed and payload.

The principal modification to the B model helicopter and, in fact, the key to the entire improvement program is the installation of a new rotor system with greatly increased thrust capacity. The

FIGURE 1

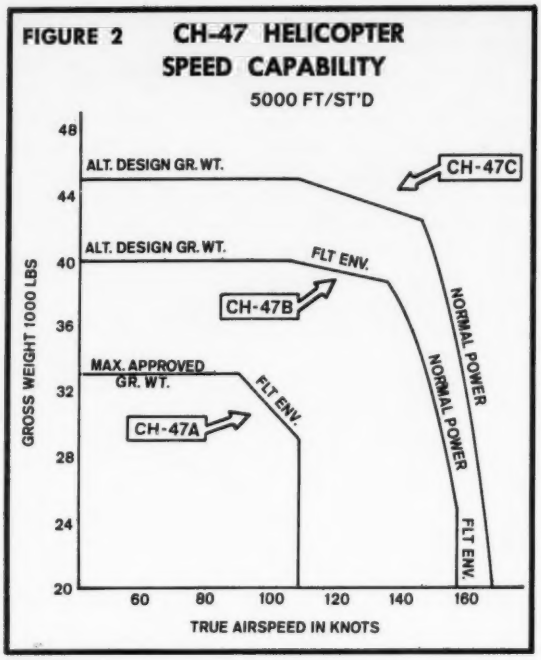
CH-47 CHINOOK
PERFORMANCE COMPARISON
HOVER AND CRUISE @ 3000 FT & 90°F
100 N.Mi. RADIUS MISSION*

Model	*CH-47A*	*CH-47B*	*CH-47C*
Engines, (2)	T-55-L-7	T-55-L-7C	T-55-L-11
T.O. Gr Wt, lbs.**	32,200	35,250	42,200
Wt Empty, lbs	18,093	19,555	20,206
Combat Equip, lbs	2242	2242	2242
Payload, lbs***	7100	8900	14,900
Cruise Speed, Wts	94	136	132
Productivity ton n.mi/hr	333.70	605.20	908.90

* Mission Description
1. Warm up 2 min at NRP
2. T.O. and cruise outboard 100 n.mi.
3. Land, exchange P. L.
4. Warm up 2 min at NRP
5. T.O. & cruise inbound 100 n.mi.
6. Land with 10% fuel reserve

** T.O. Gr. Wt. limited to hover O.G.E. capability
*** In bound P.L. is 1/2 outbound P.L.

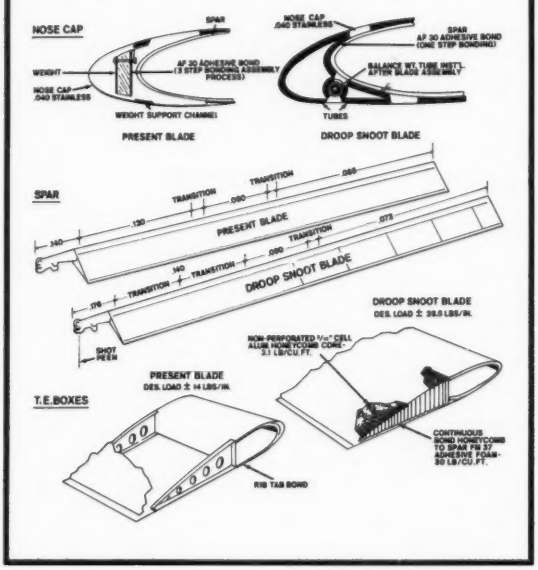
FIGURE 2 CH-47 HELICOPTER SPEED CAPABILITY



Notes

1. **CH-47A speeds per oper. man. flight envelope.**
2. **CH-47B speeds limited by normal power based on APE I testing or by flight envelope.**
3. **CH-47C speeds limited by normal power based on Army test results or estimated rotor aerodynamic limit.**

FIGURE 3 DROOP SNOOT BLADE



evolution of the helicopter system has seen the installed power steadily increase from 3,880 shp to 5,300 shp and many structural changes made, such as to the landing gear with its attendant higher flotation. This evolution has fostered continual increases in the operating gross weight of the helicopter to 33,000 pounds. However, the rotor system has remained until just recently sized to the original gross weight of 24,500 pounds, thereby imposing significant aerodynamic and structural limitations on the operator.

Figure 2 shows the gross weight versus airspeed envelope in effect for the CH-47A and CH-47B and projected for the CH-47C model at 5,000 feet density altitude. The CH-47B and CH-47C have increased alternate gross weights to 40,000 pounds and 44,800 pounds respectively. In comparison with the power limits entailed with the T55-L-7 series engine, the airspeed of the A model is severely limited by the present symmetrical blade aerodynamic limits which may not be exceeded without retreating blade stall, high control loads, and serious reductions in fatigue lives of critical dynamic components.

The more direct relief to this limitation is to provide increased blade area which is a characteristic of the new blade by virtue of its 6 inch increased radius and 2.25 inch increased chord. The resulting 12 percent increase in blade area provides approximately one-half the improvement in lift capability. The remaining lift comes from adopting a cambered (droop snoot) leading edge and reflex (bent up) trailing edge airfoil configuration to replace the symmetrical section.

Droop snoot blades are not new; they are being pursued by Bell and Kaman, and are now in production on the Vertol Marine CH-46D. However, the approximately 20 percent greater lift coefficient than the symmetrical blade combined with the increased blade area yields rotor aerodynamic limits that are compatible with the engine normal rated power curves in figure 2.

The new droop snoot blade is based on the same stainless steel D spar extrusion with increased transition wall thicknesses and shot peening for increased fatigue strength. Improved assembly and bonding techniques and greater bonded areas are featured together with a fiberglass covered trailing edge fairing, which is honeycomb filled as a change from the former aluminum ribbed boxes (fig. 3). Additional reliability and maintainability improvement changes have been made to the trailing edge and tip cover. Details of both blade constructions are shown in figure 3.

To enable the higher speed potential of the improved helicopter to be realized, measures were taken to improve the stability and vibration characteristics consistent with the increased airspeeds. With respect to stability, providing the pilot with a 1 second time delay before having to respond to a possible stability augmentation system (SAS) single-axis hardover was a controlling consideration.

To reach this objective, a development program was completed during 1966 in which a considerable increase in directional static stability was achieved. This was attained aerodynamically by blunting the trailing edge of the aft pylon, adding spoilers to the forward pylon, and attaching afterbody strakes to the fuselage. Figure 4 illustrates the improvement in the static directional stability derivative of the CH-47B relative to the CH-47A model. Improvement in the inherent directional stability permitted the SAS authority to be reduced, which in turn increases the response delay time or the speed at which a 1 second response time can be obtained.

A vibration absorber network has been installed in the cockpit, cargo compartment and aft pylon. The absorbers, 90 and 120 pound sprung weights, are tuned to the natural forcing functions of the rotor and are installed one each under the pilot and copilot's seats, one at the nose enclosure and two in the aft pylon beneath the canted deck. A two to one reduction in three per rev vibration levels has been obtained. The absorbers will be retuned for the C model's 243 rotor rpm.

Two changes, not initially programmed, have been added to the CH-47B configuration. It was recognized that the CH-47B would be at least 1,000 pounds heavier than the A model due to the heavier blades, absorbers and component strengthening. To offset this increase in weight empty, until such time as the 108 B models would be retrofitted to C models, an uprating of the L-7 engine from 2,650 shp to 2,850 shp was introduced.

This engine, termed the T55-L-7C, was qualified in September 1966 and primarily consists of a new atomizing type combustor. Its more even burning permits higher temperatures and power. Better altitude and cold starting characteristics and multifuel capability are additional advantages of the L-7C, making it attractive to update all L-7 engines to this version at overhaul.

The most recent addition to the CH-47B model is the incorporation of structural provisions for additional fuel cells that make up part of the C model. Although the qualification schedule for the cells themselves is too long to make the B model, future retrofit incorporation is greatly facilitated by putting in the backup structure while the helicopters are being initially manufactured.

End objective of the Chinook improvement pro-

FIGURE 4

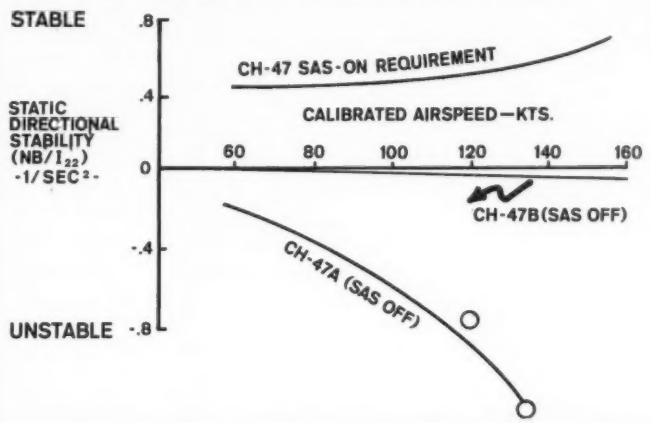
STABILITY IMPROVEMENT CH-47B

1. DIRECTIONAL STABILITY

FORWARD PYLON MODIFICATION | AFTERBODY STRAKES | BLUNTED AFT PYLON

2. SUMMARY-DIRECTIONAL STAB. IMPROV. TEST RESULTS

G.W.= 28,550 LBS CENTER OF GRAVITY=18" AFT



The Improved Chinook

gram is the CH-47C. The C model is built around the installation of the 3,750 shp T55-L-11 engine and is the eventual marriage of the increased thrust rotor in the interim B model with the higher power engine. It is this combination that meets both operational requirement objectives of increased payload and speed plus range performance.

The L-11 engine picks up the atomizing combustor, qualified on the L-7C engine and adds compressor and turbine redesigns to increase airflow and improve efficiency. The inlet guide vane and first two stages of the compressor have been modified to a transonic configuration. A second stage gas producer turbine has been added, together with provisions for cooling the first stage turbine blades and nozzle vane. The power turbine has been moved aft to accommodate the second gas producer turbine and features improved airflow design. An additional improvement to the L-11 is the incorporation of a torque/speed control which will provide no droop rotor speed governing for all loads and speeds and equal load division between engines.

Increased airflow and pressure ratio of the L-11 combined with greater turbine efficiency have provided large improvements in both power and fuel consumption. The turbine cooling provisions can be expected to result in long turbine life. For any given shp level, the L-11 has lower specific fuel consumption and lower turbine inlet temperature than the current L-7 engine. The 50 hour preliminary flight rating test (PFRT) on the L-11 was completed in May 1967.

The L-11 has an output speed of 16,000 rpm which will raise the Chinook's rotor speed from 230 to 243 rpm. A change in gearing at the aft transmission accessory section will be made to keep the alternators and flight control hydraulic pumps in their present operating ranges. Other changes to the transmission system to accommodate the increased engine power are more extensive — particularly in the engine nosebox and combiner transmission.

CH-47C transmissions will have a twin engine rating of 6,000 horsepower compared to 4,970 horsepower for the A model. This horsepower increase when combined with the increased rotor speed constitutes but a 14 percent increase in driving torque. Forward and aft transmission redesigns are therefore relatively minor, being material and processing changes. The engine nosebox and combiner transmission have been redesigned to take the single engine 3,750 shp 10-minute rating of the engine in an emergency, engine out condition. Here wider face gears have been employed and a bolted joint spiral bevel gear in the nosebox, the one new design feature in the C transmission system.

The new fuel cells will become effective with the CH-47C and will consist of four 130 gallon cells, two on each side fore and aft of the present tanks. Total fuel capacity will go up to 1,141 gallons from 631 gallons. With a 30-minute reserve, the CH-47C can essentially double its radius of action or have enough endurance to fly twice the number of sorties without refueling.

Figure 5 shows the complete improved Chinook configuration, made up of both B and C model modifications. Their relative performance is best summarized by the payload radius curves in figure 6, keeping in mind the airspeed advances accrued by the new rotor (see fig. 2).

Advantages of the improved Chinook are not confined to performance alone. Improvements are also forecast in maintainability and reliability factors. The inherent availability rate of the aircraft is expected to increase by 8 percent due to a calculated reduction in nonscheduled maintenance of the redesigned components. Maintainability has been considered in the redesigns. For example, a grease lubricated swashplate will replace the oil immersed bearings, a feature of the old swashplate which proved extremely difficult to seal. Greater structural margins and overall lower vibration levels are expected to materially reduce maintenance, premature component removals and repairs.

The improved Chinook program is being directed from the Chinook Project Management Office, U. S. Army Materiel Command, Washington, D. C., in conformity with the organizational relationships already in effect for the CH-47A. The contractual agency for the improved Chinook, both airframe and engine, is the U. S. Army Aviation Materiel Command (AVCOM), St. Louis, Mo. Detailed engineering responsibilities are being dispatched by AVCOM's Directorate of Research and Engineering (RD&E). The newly activated Flight Standards Group within AVCOM RD&E is performing the flight certification function. Engineering flight test will be conducted by AVCOM's Aviation Test Activity at Edwards AFB, Calif. That activity has just completed a preliminary test of the CH-47B model at the Vertol plant.

The improved Chinook B and C models will be subjected to a full range of operational suitability and logistical tests at the U. S. Army Aviation Test Board, U. S. Army Test and Evaluation Command, Fort Rucker, Ala. A service test on each model will be followed by an extensive logistical evaluation and flight test program to confirm time between

FIGURE 5

CONFIGURATION DEFINITIONS

CH-47B CH-47C

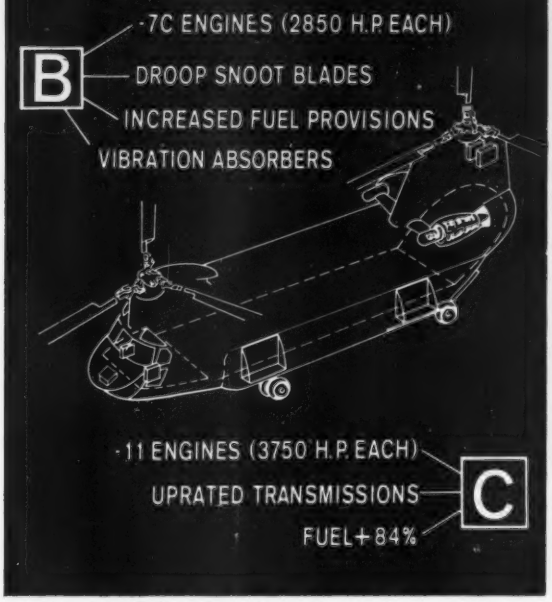
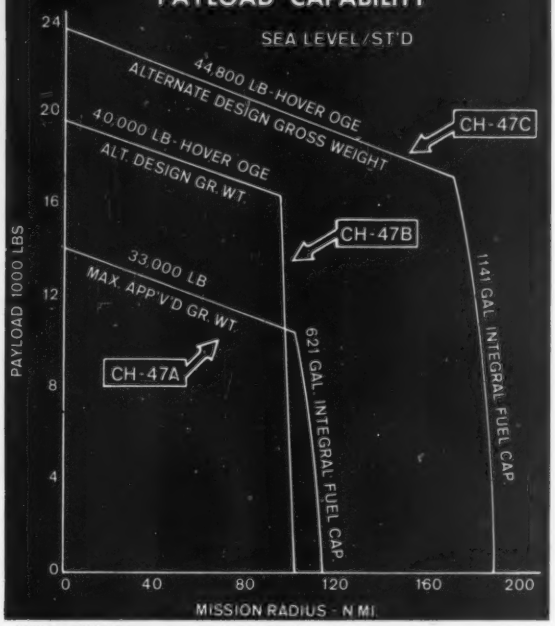


FIGURE 6

CH-47 HELICOPTER PAYLOAD CAPABILITY



overhaul (TBO) intervals on dynamic components.

Because of later qualification of the L-11 engine in August 1968, deliveries of CH-47s with L-11s installed will begin in December 1968. Intervening helicopters, between March and December, will be delivered with L-7C engines, which are interchangeable with L-11s. The interchangeability feature between engines is an inherent strong point of the program which makes it feasible, time-wise, to respond to the requirement. The program to change out engines will await the production buildup of L-11 engines to a level which will support both production aircraft delivery and retrofit.

It should not be assumed that the mating of a growth product improvement program with expanded military requirements will happen as a matter of course without foresight and planning. The inherent capability of an aircraft needs to be recognized during its early service life and steps taken to provide for its fruition. Such was the case with the Chinook, both its airframe and engine. The structural potential of the Chinook was uncovered during its static test program at Wright Field in 1962, where it was determined that much higher load factors could be sustained with but minor strengthening of two components. These two noncontractual changes were made and since

Mission Description

1. Warm up 2 min. @ NRP.
2. Take off, cruise out @ SL/St'd.
3. Land, drop payload, reload 1/2 outbound payload.
4. Warm up 2 min. @ NRP.
5. Take off, cruise back @ SL/St'd.
6. Land with 10% fuel reserve.

Notes:

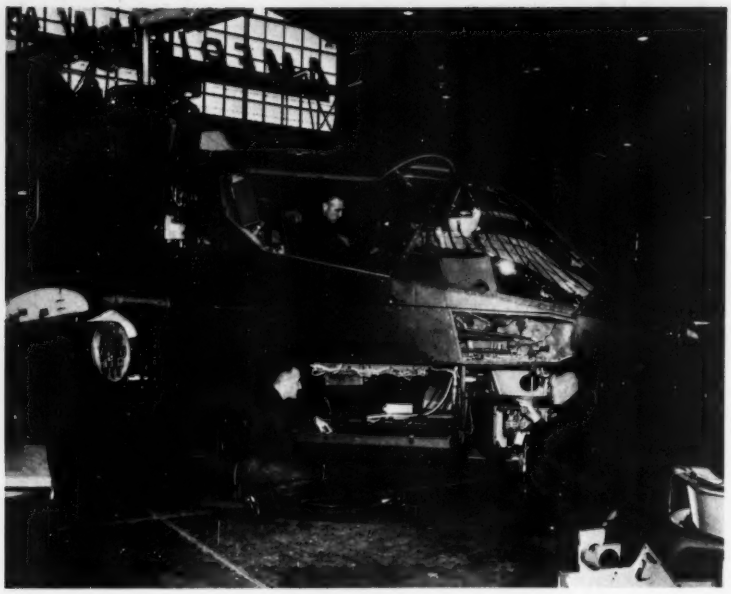
1. CH-47A cruises @ flt envelope speeds.
2. CH-47B & C cruise @ 99% best range speed except where limited by flt envelope speeds.
3. Weights:

	CH-47A	CH-47B	CH-47C
Empty:	17,932	19,375	20,016
F.U.L.:	719	719	787

that time other engineering changes to the Chinook were incorporated with an eye toward future growth.

Similarly the engine development has followed the same approach. Redesigns incorporated in the T55 engine to enhance its altitude capabilities were initiated in 1964 and constituted the earliest actions which became the T55-L-11 configuration.

Applying the technical vision which recognizes growth potential does not penalize the helicopter with significant cost or weight penalties. On the contrary, the Chinook program is an example of gains in mission accomplishment, productivity and cost effectiveness that can be obtained through a continued awareness of product improvement potential from the development cycle onward.



Three members of the Army's New Equipment Training Team (NETT), who are to introduce the HueyCobra to Vietnam, undergo ground training at the Fort Worth, Texas, facility of Bell Helicopter Company, which is manufacturing 530 of the high-speed, tandem-seat gunships for the Army. Seated in the pilot's cockpit is CWO John D. Thomson. Inspecting the ammunition bay are CPT James T. Pratt, left, and CPT Jerry W. Childers

Cobra NETT

(New Equipment Training Team)

PERSONNEL who will be the first to fly and maintain AH-1G HueyCobras in Vietnam are receiving in-country training from a 55-man New Equipment Training Team (NETT).

First contingent of the team left the United States for Vietnam in March of this year. This part consisted of four specialists in the T53-L-13 engine. Three were trained by the Lycoming Division of the AVCO Corporation, maker of the engine. The other team member was trained by the Chandler Corporation, maker of the fuel controls.

The Cobra uses the T53-L-13 engine, which is the same engine used in the uprated version of the UH-1D. This engine differs from the T53-L-11, used in many Hueys, in that it incorporates a second compressor and power turbine, a variable inlet guide, and an atomizing nozzle.

The other 51 members of the team to introduce the Cobra to Vietnam left the United States in August and began their teaching program in September. This part of the team consists of 13 officer and warrant officer pilots, 25 enlisted men, 6 Bell Helicopter Company civilians, 3 men from the U. S. Army Weapons Command and 4 from the U. S. Army Electronic Command.

All members of the team along with their six HueyCobras and training aids were airlifted to Vietnam. The training aids were especially made for HueyCobra training and are the same ones used by the team in their own training.

The Vietnam NETT was a part of 350 Army helicopter specialists who were selected to receive initial HueyCobra training. Most of this training was conducted by the Bell Helicopter Company at their plant in Hurst, Texas. It included flying, maintenance, stability, augmentation systems, avionics, and trainer maintenance. Some members of the team received turret training from the Emerson Electric Company.

Other members of the team also received gunnery training in systems used on the Cobra. The Cobra can carry mixed ordnance loads of 1,525 pounds of 7.62 mm, 40 mm, and 2.75" rockets on a typical mission of 2½ hours endurance, half at cruise speed of about 150 knots and half at loiter at 90 knots.

Those trained in the special school who did not go to Vietnam will remain in the United States as instructors or as specialists connected with the HueyCobra program.

The NETT in Vietnam will have its own maintenance capability and will teach some seven courses simultaneously, including both flight and ground courses.

Tales of a Tired T-41

Captain Steven E. Selman

"NOW LOOK DOC, it's like this. Well, first of all, I've got family problems; besides, I didn't ask to get drafted. Basically I'm a civilian. Sure, I was beefed up for this job. Yeah, I've got more zing in the old motor and all. But sometimes I feel like these guys are wearing me out. Up at the break of dawn and then go, go, go until sunset, day in and day out.

"I'm not thinking of burning up my 2408 card, Doc. I'm patriotic and all. Even as a civilian I was called 'Hawk,' not a 'Dove.' Yeah, they always call me 'Sky Hawk.'

"Well, OK, I'll get to the point. Like it says on my –13 over there, my 'brake handle came loose.' 'Came loose,' my landing gear! That ape yanked it loose. I know these guys are taught that we are designed to have the lowest possible weight; that if the weight of any of my parts, like my brake handle for example, were increased by 1 pound my gross weight would have to be increased by 10 or 20 pounds for me to give the same performance.

"You know, Doc, more weight means more fuel, more landing gear, more thrust, more engine, requiring more wing, and so on. Well, that student knew that. But just because it looks like the brake handle on a Mac truck doesn't mean it's built like one.

"Remember two months back when that sadist rounded me out about 6 feet too high. Well, I held on with every last rivet, but heck I'm not *that* beefed up. I can still feel the pain. I was in surgery for almost a month. Guess that government medical insurance is one advantage to being in uniform. Isn't there an old aviation expression 'Fly like a lover, not a gorilla' or something like that?

"I've got to admit it, Doc; it's the little things that have really been getting me nervous lately. Sometimes I can't even keep my chip light from going on.

"When I'm on the ground, I'm supposed to be *taxied,* not driven. Just because cars are designed to look like airplanes doesn't mean that I should be driven like a car. I keep wanting to yell, 'Hey, I've got wings out there.' Doc, maybe you could put a placard on me that says THIS IS AN AIRPLANE.

"I'm not unfriendly, but I didn't enjoy shaking hands with that tree at 5 mph. And I was never more embarrassed than when that student slid my wing onto Gertie-Gas-Tanker's backside – they even took pictures of that scandalous affair.

"Now take the handle of my window latch, for example. The checklist says 'window locked before takeoff,' not half locked. If it isn't fully closed, that old window could rip loose on takeoff and get caught on my elevator control surface. And sometimes they slam my door like they were closing up the Bastille. Ouch, that hurts!

"But it's those clear days with good visibility that get me as nervous as a long tailed cat in a room full of rocking chairs. That's when 4 out of 5 mid-air collisions happen. I've had more near-misses than some of my solo pilots know about. The way one or two students fly, I'd like you to requisition plexiglass stomachs for them."

"What about your family problems, Sky?"

"Heck, do I have to get into that, Doc?"

"It might help."

"Well – shoot – OK. It's my granddaddy and my cousin who keep bugging me . . . When do I get to go to Vietnam? My granddaddy Bird Dog can do it, can't he? And you ought to hear my cousin Moe brag about his heroics."

"Your cousin Moe, Sky Hawk?"

"Yeah, I sure wish that loudmouth Mohawk would lay off me."

"You know, I feel much better now that I've got it off my fuselage, Doc. Sometimes, deep down in my fuel pump, I still feel like a civilian."

Construction Power and Air Power

Continued from page 5

The helicopter has brought a new dimension to airmobility and airlift concepts. The short-haul mobility in the battle area is almost exclusively by helicopter, while the long-haul, heavy lift is still provided by fixed wing cargo aircraft. The UH-1 is used to great advantage by engineers for road and airfield reconnaissance, command and control, and to lift engineer troops into isolated areas. In all the divisional engineer battalions in Vietnam, the UH-1 is used almost continuously for reconnaissance, much of which would be impossible without the helicopter.

Airlift of engineer equipment has come a long way since dozers and graders were disassembled into numerous loads and flown into China. CH-47 helicopters lift TD-340 dozers and 3414 front loader/backhoes in and out of road and landing zone sites with great regularity. Sectionalization of engineer equipment is still progressing with greater efficiency and detailed plans for rapid disassembly, transport and reassembly.

The Caterpillar 112 motorized grader is sectionalized into only two components, the front portion being lifted by a CH-47, while the rear portion is lifted by the CH-54 Flying Crane. The D6B dozer is sectionalized into only three components, the track and blade each lifted by the CH-47 and the power unit by the CH-54.

An important feature in airlift of engineer equipment by helicopter is that the equipment is placed where it is needed, not at a distant airstrip as it was in the past.

Engineer troops and construction equipment are not the only requirements for airlift support. Construction materials are lifted into isolated areas when necessary, and fuel for motorized equipment is delivered in 500 gallon fuel bladders as helicopter slingloads. The five water purification sets of the 8th Engineer Battalion are transported almost exclusively by UH-1s as far forward as possible in support of assault battalions.

General Williams has pointed out that the integrated use of airmobility in Vietnam and the split-second timing afforded by modern communications systems has resulted in a command and control situation that military men have always dreamed of. Engineer responsiveness in infantry divisions in Vietnam is evidenced by their ability to fly into an area with only the bare essentials, determine the engineer effort required, call for necessary materials and equipment, and have it on the site with a rapidity never before thought possible. This is the airmobility that provides the best possible engineer support to the combat mission.

From the Burma Road on the China-Burma frontier to South Vietnam 25 years later, the U. S. Army Engineers are again providing construction power in Asia, and again air power is playing a vital role. From the L-5s to the UH-1 Hueys and the CH-54 Flying Cranes, there are 25 years of progress which give the engineers in Vietnam mobility never dreamed of by those of us engaged on the Burma Road.

Increased tactical air and ground mobility has not lessened the requirement for engineer support as many believed it might. On the contrary, it has increased. But thanks to air support, engineer construction power is more responsive to the needs of military operations than ever before. With the continued bright future of Army aviation and airmobility, Army engineers will not only rise to support it, but will gain maximum benefit from it as we continue our primary mission of combat and construction support of the greatest United States Army that has ever taken the field.

A CH-47 places a common cap on corbels of a 200-foot Bailey bridge in Vietnam

COURTESY AND COMMON SENSE

While turning on final a reflection on the plexiglass caught his eye— and a Huey autorotated into position smack in front of him

Captain Adam E. Runk and CW2 Carl L. Hess

IT WAS THE end of the day and several helicopters were returning to their field. The pilot of a Huey was told to report turning left base for landing bravo panel north. Before turning base leg, the aviator scanned to his left and noted one Sioux on short final. The pilot reported turning base leg and was cleared to land number three. Once again the man looked carefully and informed the tower that he only had one other aircraft in sight. The tower operator nonchalantly reported the unseen aircraft was *under* the number three aircraft. Needless to say, a go-around was immediately initiated by the number three aircraft.

The pilot looked down and reported that the number two aircraft was at treetop level a half mile from the field. Except for an alert tower operator, the chances are good that the number two and number three aircraft would have met somewhere in the vicinity of the panel.

In another instance, at a different field, a TH-13T, carrying an instrument instructor pilot and his student, had been told to report a right base landing to the south. The IP flew a normal base leg, reported turning base, and was cleared to land number one. As he turned to final, a reflection on plexiglass caught his eye – and a Huey autorotated into position ahead of him. The IP of the aircraft that had been cleared to land had literally to stand his aircraft on its tail to avoid hitting the other helicopter.

One evening at dusk, another Huey was approaching an LOM (locator outer marker at 3,000 feet on a night instrument training flight. Suddenly the IP saw an O-1 climbing by scarcely 100 feet away. The IP of the Huey took evasive action and the student jerked off the hood in time to get most of the tail number of the Bird Dog.

Later, in talking to the pilot of the Bird Dog, it was learned that he had seen the Huey from the time they took off. He simply had not realized the danger involved in flying that close to a helicopter from underneath. Not only was a dangerous situation involved, but also the helicopter student gained almost nothing from this period of instrument instruction. The IP's chain of thought was interrupted and the student was upset, so little training was accomplished.

Today, almost any time you turn on your radio or television you see or hear the pitch about the good drivers in a moment of inattention being involved in a bad automobile accident. They point out that about half of the fatal auto accidents involve good drivers. They also emphasize that being right is not good enough. You must drive defensively, looking out for the other fellow.

What applies to auto driving applies doubly to flying – particularly in a congested area. Be willing to "go the extra mile." If your aircraft and another are converging for what appears to be the same spot on final, take the initiative, swing out and come in behind him.

Losing a couple of minutes is not nearly so bad as losing a lifetime.

CPT Runk is assigned to the Dept of Rotary Wing Training, USAAVNS, Ft Rucker, Ala.

CW2 Hess is now serving in Vietnam.

Can Do

Lieutenant Colonel Kenneth D. Mertel

TEN YEARS AGO a newly graduated Army aviator, silver wings gleaming proudly on his chest, reported to his first duty assignment with great expectations. Often he had become disillusioned and demoralized within a few weeks by the nonprofessional attitudes he met: the overage in grade officers lacking ability to accomplish little but cockpit duties, the reluctance of so many to fly in weather conditions, failure to exercise instrument ratings, little regard for missions, overemphasis on safety. In some units the idea that if you don't fly you have a low accident rate became all-important. This presented a discouraging view to one embarking on a new career.

How different today is the expanding and revitalized Army aviation program with its professional "can do" Army aviators. As one looks back he wonders how the changes in attitude and expertise came about. I think Army aviation matured in 1962-1963 in Vietnam with such units as the 120th Airmobile Company, first with the old "Flying Banana" and then with the UH-1A and B; the 118th Airmobile Company; and the many other fine Army aviation units that were in Vietnam during that early period. Stature increased with their dedicated support of the South Vietnamese Army and U. S. Army advisors, carrying them into battle and performing the many and varied jobs that only Army aviation can do.

It was at this time that the Army aviator fully realized and appreciated the important part he plays on the Army team and what he can contribute to that

Army aviation has played a ment of the "can do" attitu combat. This attitude is not many places in Vietnam. For (above) has just returned fr mission and learns that a soldier awaits his assistance was airborne again on anoth a trooper of the 3rd Brigad prepares to move into a fire having been airlifted into th helicopters. At right, an Arm the 73rd Aviation Company surveillance mission over Vie trymen such as those below to seek out and engage the

LTC Mertel is attending the U.S. Army War College, Carlisle Barracks, Pa.

Ten years ago a newly graduated Army aviator within a few weeks often became disillusioned and demoralized by the nonprofessional attitudes he met. How different it is today in the expanding and revitalized Army aviation program with its professional "can do" aviators. How did the changes in attitude come about . . .

major role in the develop-ude among Army troops in ticeable on many faces in example, an Army aviator from a medical evacuation nother critically wounded e. Seconds later the Huey ther mercy mission. At left, de, 25th Infantry Division, efight against the VC after he troubled area by Army my OV-1 Mohawk pilot of y prepares to leave on a etnam in support of infan- who penetrate the jungles Viet Cong.

team. I think he realized then that he provided a major contribution. At the same time, his nonflying team member also began to realize that Army aviation was not a toy or a passing fad but could contribute mightily to successful combat operations.

Army aviation also matured with another pioneer organization in South Vietnam, the Utility Tactical Transport Company. Originally from Okinawa and formerly a transport unit, this early arrival in Vietnam became the first gun company, the pioneer of the armed helicopter in combat. The year 1963 saw this unit really come of age in learning how to improvise weapons systems, especially machineguns and rockets. It saw also development of techniques for armed helicopter employment and the fight for adoption and use of the armed helicopter as a fire support means.

Commanders of this unit, such as Lieutenant Colonels Ivan Slavich, Bob Reuter, Pat Delavan and Bob Runkle (then majors), are due great credit for bringing the armed helicopter into practical use in combat. Widely adopted now throughout the services, this fact in itself is a tribute to their efforts and the efforts of the motivated officers and men who worked with them.

Employment of the Caribou in Vietnam proved the use of this efficient light transport and the need for it in support of the Army. Its ability to supplement other transport type aircraft employed within Vietnam made it an outstanding member of the Army team. The organization, development, and progress of the 1st Aviation Company in the United States under the command of LTC William G. Hooks (then major), and the trials and tribu-

lations of service in Vietnam and Thailand as it became of age, are typified now by the continued use of this aircraft to support the Army team, although the Caribou is now flown by "blue-suiters."

Full development of Army aviation began also with the 11th Air Assault Division (Test) in 1963, 1964, and 1965 and a high Army priority for new materiel and personnel in organizing a new Army division which would combine the best tactics, ideas, and equipment in movement, firepower, communications and command control, intelligence and reconnaissance, and logistics.

Finally, maturity saw the wearing away of reluctance of many leaders to employ all of the Army's assets to do the job that was to be done — a new awareness of professionalism and the "can do" attitude to accomplish the mission. This professionalism was evident in aviators knowing their job and being trained to the high degree that they perform only as dreamed of before: flying tactically in and out of small fields and strips, low level on the treetops; learning to live with the weather; using the technique of the air assault, carrying an airmobile infantry battalion into battle mounted on helicopters; involving their complete integration into all of the combat power in the division.

The year 1965 saw deployment of the 11th Air Assault Division, newly designated the 1st Cavalry Division (Airmobile), to Vietnam. This was the turning point—from where it was likely that the Viet Cong and North Vietnamese Army were to be victorious to the first air assault in combat that reversed the course of the war—which enabled the 1st Air Cavalry Division to dominate within a few short months the II Corps tactical zone in the Republic of Vietnam.

II Corps jokingly became known as the "Pasture of the First Horse," and that horse became very familiar with all parts of it. He knew every hill and valley. He knew the weather and how to live with it. He knew where the enemy now was and would likely be. As a result, Army aviators in this unit performed some of the most professional flying that has ever been accomplished.

In October 1965, an assault helicopter battalion on one side of a mountain pass prepared to move across the mountains to pick up an infantry battalion assault force on the east side of the pass. As H hour approached the weather closed in. The commander of that assault helicopter battalion found a way to bring his battalion in through the narrow pass on the road one at a time, some around through a narrow fog-filled valley, to the pickup zone and the waiting infantry so the mission could be carried on.

This mission could have been called off for weather; however, due to the ingenuity and initiative of the 227th Assault Helicopter Battalion commander the mission was accomplished. The objective was taken by the infantry and the advantage offered by a timely location of the enemy was successfully acted upon.

On a second assault landing a few days later a new technique was developed — that of landing on the very hilltops, one bird at a time if necessary. During this particular operation the fog was so heavy that the birds could scarcely be seen or see one another as they flew through the fog and haze to land on the pinnacle, drop the infantrymen, and move out. Once again, outstanding professionalism was displayed by every aviator, his battalion, company, and individual.

In early December 1965 a true air assault, airmobile type exercise was conducted south of An Khe. For the first time in combat the infantry troops were rappelled from UH-1D helicopters, followed by employment of the Chinook ladder, to land the battalion into tiny postage stamp landing zones carved out of the jungle growth. This first combat rappel in Vietnam was conducted by Company C, 1st Battalion, Airborne 8th Cavalry, supported by the 227th Assault Helicopter Battalion.

This first assault was accomplished with little fanfare or previous training by either the infantry troops who climbed up and down the ladders or the Chinook pilots who performed this feat from the 228th Assault Support Helicopter Battalion. On rappel, the birds come in fast and must be held very steady for a few seconds over the jungle growth as the ropes are tossed down and the troops quickly slide down to the ground. The ropes are released or pulled up and the birds are away.

With the Chinook ladder, the company that made this first assault and the pilots had minimum opportunity for training. The rifle company saw one squad from that company climb the ladder up and down once during a demonstration, so they were familiar with the technique. The company's first movement on the ladder was in the assault and to the landing area under combat conditions.

Professionalism was also demonstrated in the use of supporting fires from aerial rocket ships of the aerial rocket artillery battalion, the supporting air cavalry, and the gunships of the assault helicopter battalions. These weap-

ons are of tremendous value to the Infantry. First, the aerial rockets assist in softening up the landing zone and then the air cavalry continues to bring under fire targets of opportunity. Second, the door guns of assault helicopters protect the moving helicopter formation, especially those last critical seconds in the landing zone between the lifting of aerial rocket fire and the landing of the troops.

Carrying in 105 cannons suspended under the Chinook helicopter, with ammunition and gun and the 155 howitzer by Flying Crane permits artillery to always support the infantry. The usual procedure is an air assault into an objective area with an airmobile rifle company to seize it, followed immediately by Chinooks bringing in 105 howitzers. The Chinooks and Flying Crane then continue to bring in ammunition needed to keep up the high volume of fire support that is characteristic of such an operation.

All this airmobility provides flexibility. Flexibility in moving the infantry to the actual location of the enemy. Flexibility in providing firepower where needed and in quantities desired. Flexibility in providing the logistics to back up the operation and the medical evacuation that is so important to a combat infantry unit.

To help destroy the enemy, a complete integration of Army aviation as a member of the Army combat team is necessary. The aviators who provide this combat support have all met the challenge as aptly demonstrated by their acceptance by the other members of the team. The infantry soldier, the artilleryman, the cavalryman, the logistician all accept the aviator as a professional, as an equal. This reward has been earned in the last several years, especially in Vietnam.

Another example of professionalism is the ability of Army aviators in Vietnam to fly 95 percent of the time, regardless of weather conditions. When we first arrived in Vietnam, the dreaded monsoon weather conditions were alleged by the newspapers to keep any flying machine grounded for a big portion of the time. How wrong they were. Be it in the delta or in the highlands, there are ways to accomplish the combat mission regardless of the weather conditions.

Knowledge of the terrain becomes all-important—know it like the back of your hand. When weather conditions are marginal, the mental picture formed in each pilot's mind as he flies through that area vividly brings back to life the valleys, the hills, and other obstacles. This, together with what he can see, enables him to operate under the most marginal conditions, conditions heretofore thought impossible. He often uses roads and valleys as guides, knowing that a particular road or valley at low level leads to the objective.

I recall one incident where air assault helicopters on a combat mission flew into a base camp to refuel when all of that aviation unit's helicopters were grounded because of the bad weather. These assault helicopters flew in, following the road into the camp, past the gate, into the tower, landed, refueled, and took off again.

On this flight as passengers was a group of senior officers newly arrived in Vietnam on an orientation flight. One can easily imagine the reaction of this group on seeing the demonstration of "can do" in these extreme weather conditions. What it all amounts to is that an Army aviator who is professional and experienced can operate the majority of the time in Vietnam and in other places in the world, in spite of adverse weather.

This "can do" attitude has rapidly spread with the organization of the Aviation Brigade in Vietnam and the adoption by that brigade of the techniques learned and proved in the 11th Air Assault Division and further combat tested by the 1st Cavalry Division (Airmobile) in Vietnam. The airmobile techniques—the ability to obtain the maximum from Army aviation in connection with movement, firepower, intelligence and reconnaissance, logistics, and command and control, under all conditions of terrain and weather—have brought this about.

As a result, throughout Vietnam one sees a truly professional attitude on the part of the Army aviator and all members of the aviation team. This attitude is catching; it spreads from the pilots to their crews, to the maintenance men and other unsung heroes who work long hours to keep the birds ready to fly. Its effect is marked on the new man when he first joins the unit and learns of its past history, participates in an assault mission or two, and sees what can be accomplished. After a few weeks with a combat unit in Vietnam, with the background he has received at the Army Aviation School, he too is a professional, ready to carry on; ready to "can do."

In the past 10 years Army aviation has truly come of age, from a gawky unconfident teenager to manhood—a full-fledged member of the Army team. It cannot help but look forward to future years of outstanding and dedicated service.

crash

sense

the following 28 pages prepared by the United States Army Board for Aviation Accident Research

COCKPIT ANIMOSITY

UH-1C PILOT: ". . . We returned to rearm and refuel. When this was completed, we had a full armament load and full fuel load. I had landed to the west, touching down south of but adjacent to the southeast corner of the pad, in the sandy area. At 1405, we took off. The aircraft commander, sitting in the left seat, warned me that he thought I'd been horsing the aircraft around too much. I had a lot of in-country UH-1B time, and UH-1C time in the U. S., but no in-country UH-1C experience, except a standards ride and another 30-minute flight the day before. Because of this, I tried to heed his warning and was extremely careful on the takeoff.

"I picked it up to a hover and pedal turned slightly to the left. Although I did not pick it up to a 3-foot hover and make a definite check of hover capability, I felt everything was OK. I did

the pedal turn, nosed the ship forward, and started the takeoff to the south. I was particularly concerned with clearing the barbed wire near the water's edge. As I cleared it, I glanced at the rpm and it had bled off to 6400. I had previously checked the low rpm warning light and horn and both were operative.

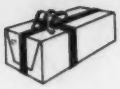
"Prior to takeoff, I put the low rpm toggle switch in the on position. At no time did I see the low rpm light come on, or hear the horn blow, during the takeoff. As I glanced at the rpm, I hit the beep button and I'm positive I beeped up. My only recollection of the water was the white glare off the water from the sun. Before I looked outside the cockpit, we hit the water . . . I did not see the impact.

"My next recollection was a rapid, lurching deceleration under water. As I recall, it seemed as if the aircraft was trying to tip up on its nose while decelerating and sinking. I put my hands up to climb out the front window, but it was still intact. I realized my seat belt was fastened, so I unlatched it. At the same time, my right foot was caught, twisted into something. As I wrestled to free it, I realized there was an opening down and to my right. I managed to back out through the opening and was free of the wreckage. . . .

"At no time during this takeoff did I feel any mechanical difficulty. I am certain that the rpm never went below 6400, or that I beeped down. At no time did I feel control pressure from the aircraft commander on the cyclic. It is my opinion that, because of my poor pilot technique, I drove the helicopter into the water."

Aircraft commander: ". . . We were south of the pad facing west. A row of barbed wire was strewn

". . . the aircraft commander warned me that he thought I'd been horsing the aircraft around too much"



COCKPIT ANIMOSITY

to our left front about 25 meters away. On takeoff, the pilot climbed over the wire. In doing so, he decreased the rpm to about 6400. We cleared the wire and he regained rpm by lowering the collective and attempting to beep it up. At the same time, we were gaining airspeed. It appeared to me that the pilot had control of the aircraft. I looked down to set the radio to make a call and we hit the water. The aircraft did not bounce or veer. It plunged to the bottom of the river.

"I managed to release the seat belt and, after feeling around, found my way out. I was the first one to get to the top. I saw the crewchief come up about 30 meters away and I started to swim toward him. The pilot came up between us and I told him to try to get the crewchief, who appeared to be unconscious.

"I then heard a scream from my rear. I turned and saw the gunner about 15 meters away. I swam to him as he was going down. I caught him by the shirt collar and went down with him. I managed to get him up two more times, but on the last time down, I lost him. I came up and saw a boat coming for us. I went down again to search for the gunner, but I was unable to find him. . . ."

Question: "Do you feel that the pilot and yourself worked as a team in the cockpit?"

Answer: "We did not agree in the cockpit. I felt that he expected too much of the aircraft. I warned him just before takeoff that the aircraft was a lot older than the ones he had flown in school. They were heavier and he was jockeying the aircraft. I felt that he was more competent in the aircraft than myself, because of his experience. I trusted him, maybe too much. He didn't like our platoon SOP for climbout at 80 knots. He liked 60 knots better, but I told him that these aircraft were just too heavy."

Analysis:

". . . The board feels that the overall efficiency of the aircraft commander and pilot to work as a team was hampered by the pilot's admitted harassment of the aircraft commander during the mission. At this point, the board feels that animosity existed between the pilot and the aircraft commander.

"During the refueling and rearming process after the first mission, the aircraft commander confronted the pilot. He told him that he felt he was too rough on the controls and these ships could not take it, due to the high density altitudes and the overgross conditions in which they were being flown. . . .

"The board determined that the sun or the glare from the water at 1400 hours was not a contributing factor to the accident. We feel that fixation, caused by the rpm loss and preoccupation with the engine instruments, in the pilot's case, and preoccupation with the radios, in the aircraft commander's case, were the major reasons for the crash.

"It should be noted, however, that depth perception over water and over land is significantly different, especially at low altitudes. The water was choppy and the river at that point is about a half-mile wide. . . ."

Flight surgeon: "The aircraft commander and the pilot had disagreed the preceding day about whether the pilot was ready to fly the UH-1C and about the tactical employment of the aircraft. It should be noted that the aircraft commander had been flying in this aviation platoon for 2 months and the pilot had only been in-country 10 days, with 30 minutes familiarization in a UH-1C the previous day with the same aircraft commander. The dissension was heightened by the pilot's insistence that he fly with the aircraft commander in the lead aircraft. . . .

"By 1400 hours, the pilot-aircraft commander relationship could be characterized as mutually hostile, to an extent which compromised their efficiency. The intensity of feeling was partly predicated by the personality characteristics of the aviators. Both were tenacious, aggressive, and competent aviators.

"A drop in rpm to 6400 and the pilot's concern with this resulted in channelization of his attention to the engine gauges. At the same time, the aircraft commander turned his attention to his radios. As a consequence, at impact, neither aviator was aware of the extreme low altitude of the ship. These deficiences of awareness were the consequence of the aviators' emotional states and their inclination to ignore each other and devote themselves to a specific task, at the expense of crew coordination. . . .

"The pilot had very little recent experience in this aircraft and very little briefing on company operational procedures. Neither aviator had specific training in the hazards of overwater flight. . . .

"This accident emphasizes the importance of thorough briefing and unit level training of recent arrivals, however extensive their prior experience. Firm, realistic, command guidance should be given, establishing training and familiarization requisites. Those directly responsible for mission assignment must assure themselves that an individual's level of competency and currency is adequate for the assigned mission. . . ."

A UH-1D was landed on a refueling pad. Approximately 3 feet of the aft part of the skids were allowed to hang over the rear of the pad. The cargo doors were closed and the crewchief and gunner cleared the pilot to remain in position. The aircraft was shut down on the refueling pad because a POL tanker was in the process of refilling the storage bladder. The main rotor blade was tied down. The aircraft commander left and went into a nearby building.

As the pilot and other crewmembers left the helicopter, it tilted backward and the tail boom stinger struck the ground. The crew and two bystanders brought the helicopter to a level attitude by lifting its tail boom.

The pilot entered the helicopter and started the engine, intending to move it forward to a better position on the refueling pad. After he attained approximately 6000 engine rpm, the personnel holding up the tail boom released the helicopter and moved a safe distance away. This caused the tail to move downward.

The pilot saw the nose come sharply up and applied collective. The helicopter rotated between a nose low and a nose high attitude and rose uncontrolled. It yawed to the left and came down, striking very hard in level attitude, and came to rest approximately 15 feet to the left rear of the refueling pad. The pilot then shut down.

The accident investigation board determined the cause of the accident was poor judgment on the part of the pilot in failing to notify his aircraft commander of the situation before electing to fly the helicopter to a better position on the pad. The action taken was extremely dangerous to the personnel holding the tail boom.

Contributing cause factors were listed as:

The helicopter was parked by the aircraft commander with 3 feet of the aft portion of the skids sticking out over the end of the refueling pad.

The crewchief and gunner cleared the aircraft commander and pilot to put the helicopter down in a dangerous position on the refueling pad.

The open cargo door locking mechanism was not present on the helicopter and the cargo doors were closed when the helicopter was landed on the pad, restricting the visibility of crewmembers.

The concrete refueling pad was not large enough to allow the entire helicopter skids to rest firmly. The skids measure 12 feet 2 inches in length, while the concrete refueling pad was only 10 feet across.

LOW LEVEL FIXATION

"I was watching the suspects running along the ground in front of us when I saw that we were not pulling out . . ."

UH-1B aircraft commander: ". . . while on a reconnaissance mission, we saw three enemy suspects attempting to elude us. We dropped smoke to mark the position, as we were flying in an easterly direction and the suspects were at our six o'clock position. The lead ship made a right descending turn to check them out. I told the pilot to take up position on the lead ship and he made a right descending turn back toward the west.

"I was watching the suspects running along the ground in front of us when I saw that we were still descending toward the ground and were not pulling out. I immediately glanced at the instrument panel and saw that we were very low on rpm and the ship began to shudder.

"I got on the controls with the pilot, kicked right pedal, and lowered the collective, attempting to gain enough rpm to carry us over a cemetery with large tombstones that was directly in front of us. The skids struck the top of one of the tombstones. I applied pitch to get us over the cemetery. At this point, I applied aft cyclic to flare and slow the airspeed.

"Our airspeed at ground contact was approximately 40 knots. We touched down at a 45° angle, right skid first, then the left, and started to straighten out. We struck a rice paddy dike that was approximately 2 feet high and the aircraft overturned on the left front and skidded approximately 25 meters on the left side.

"As soon as it came to a stop, I shouted for the crew to get out and discovered that the aircraft was upside down and I was pinned against the seat. The engine was still running and I cut the switches. The crewchief helped me release the seat belt and harness and I got out through the front right window. . . ."

Findings:

"The crew demonstrated poor technique and exceeded aircraft limitations in a diving, turning maneuver too close to the ground.

"Concentration on the lead aircraft and target diverted their attention from flying the aircraft, critical during low level maneuvering.

"This crew had been on alert status for 24 hours and had flown two missions, one after dark, on the previous day. Quarters and recreational facilities are provided on the flight line for alert pilots. However, rest gained under standby conditions is not as conducive to alertness as rest gained during off-duty hours.

"The pilot, though experienced in UH-1D operations, had only 13.7 hours in UH-1B gunships and was on his first flight with XM-5 equipment when the accident occurred. . . ."

FOLLOW THE LEADER

UH-1D aircraft commander: ". . . I cranked, ran up, checked commo, and departed at 0635 as number five in a flight of six. We arrived at the airfield at approximately 0645 and landed on the left half of 09, the active runway on the east end. Up to this point, I had noticed no unusual incidents and the aircraft was performing well.

"Although it was still night, it was light enough so that no lights were needed for landing. However, the instrument lights were on and the navigational lights were turned on steady dim. The rotating beacon was not on. This landing was made with no difficulty.

"I was flying from the left seat and the pilot did not touch the controls before or during the crash. There were no unusual dust conditions or restrictions to visibility, except for darkness, while making this landing. Following company policy, we landed in trail and brought the aircraft to rest with about 5 feet clearance between aircraft.

"Our flight leader instructed us to pick up and line up to the left, or north side of the runway, off the runway, facing east, to refuel to 1,200 pounds, and to come forward to the lead aircraft for a briefing. I don't recall anything in these instructions that could be construed as a warning about the dust. Further, there were no instructions given regarding aircraft spacing, either in distance or time intervals, or anything of a precautionary nature.

"The aircraft moved out one at a time, hovering diagonally to the northeast, off the runway into the dusty area on the north side and set down facing east, each waiting for the ship in front to set down, allowing the dust to partially dissipate before the next one moved out.

"After number four aircraft had moved out diagonally and set down, I waited for the dust to partially settle, then picked up to a hover of about 3 feet and began to move diagonally to assume my position behind number four aircraft. I did not look over the area north of the runway as closely as I should have prior to hovering. It was like following the leader. However, while hovering, I was thinking about the dusty conditions and spacing, and decided I would not close up to the next aircraft as tight as usual.

"Although the dust was very bad, I still had visual contact with the ground, but could see only the lights of the number four aircraft as I hovered into position. I did not see any foreign objects in or on the ground, such as metal stakes, empty sandbags, etc.

"As I hovered into position and was about to terminate, my distance to the next ship was about 15 feet, but it was really difficult to gauge. I had complete control of the aircraft and situation, and everything seemed in good order.

"The instant I lined up and just prior to touching down, I heard a pop from the rear and the air-

when the spin started, I felt as if I was being thrown out of the aircraft . . . I lost all ground reference and experienced vertigo . . .

craft entered a violent spin to the right. . . . I had no sensation of ground contact, or hitting anything, or of anything hitting the aircraft.

"When the spin started, I felt as if I was being thrown forward out of the aircraft. The aircraft popped up into the air, as if from a slight pitch pull. This was evidently my first reaction. I must have flinched initially, pulling pitch and causing the ship to rise. How high it rose I could not tell, but I realized it was going up, and that I had probably pulled pitch. I stopped it by applying slight downward pitch.

"The nose did not pitch up. Instead, the whole aircraft went up. I estimate it occurred in the first 90° of a complete 360° turn to the right.

"Once the spin started, I lost all ground reference because of the dust and I experienced vertigo. I think I stopped the rise after about 180° of turn. I knew I had to get the aircraft on the ground. I had no pedal control, so I eased the collective down, searching for the ground. The aircraft made at least a full 360° turn before I was able to get it on the ground.

"During the violent spin, I wasn't aware of any rise in rpm. I didn't glance at the rpm or hear a rise in the engine. Ground contact wasn't particularly hard, but the left rear skid collapsed and was in a ditch, which caused the aircraft to turn on its left side at about a 45° angle. . . ."

The tail rotor blades hit a metal stake protruding out of the ground, causing the helicopter to crash.

Analysis:

"The fact that the aircraft commander failed to recognize the antitorque failure condition and did not execute known antitorque failure emergency procedures is considered a contributing factor to the extent of damage. . . .

"Dust and light conditions greatly reduced visibility. Either condition alone was sufficient to reduce visibility to the point of restricting sight of a metal OD stake.

"Supervisory— The flight leader, on his first flight to lead an assault, received no instructions concerning his duties or responsibilities. Further, not having received instructions, he failed to issue specific instructions on the method in which he wanted the aircraft to be manipulated to accomplish a safe lineup. The flight leader was thinking in terms of one aircraft, not six. Also, he probably had not received any training for flight leading, or thinking in terms of a whole flight as opposed to only a portion of a flight.

"Excessive flight time— The aircraft commander had a recent history of excessive flight time. His many hours of flight time, day after day, caused him to become complacent and lax, thereby developing a "follow the leader" attitude. This contributed to his failure to examine the area of the lineup prior to and during hovering. This indicates a supervisory factor on the part of those responsible for flight scheduling. The dictates of operational commitments were considered in this analysis."

SHARK BAIT

O-1E pilot: "I preflighted the aircraft and issued a flak jacket and headset to my observer. He had been flying for almost a year and was completely familiar with safety procedures, so I did not give him a briefing before he entered the aircraft. We planned no extended overwater flight, *so I didn't issue any overwater gear. . . .*

"Flying within easy gliding distance of the shore at approximately 1,000-1,500 feet, we saw five or six people in the water, apparently digging clams. We also saw five or six sharks approximately 800 meters east of them and it appeared that the people did not see the sharks. While circling, I talked over the possible danger of the sharks with my observer, and we decided to fire a rocket at the sharks, hoping to drive them off.

"Heading generally south, I put carb heat on and started a power-off glide at approximately 120 mph and fired one high explosive rocket into the school of sharks. After firing the rocket, I continued the glide to low level to watch the sharks. When I reached low level, I brought the nose of the aircraft up, applied power, and started a gentle right turn. The engine began sputtering and I realized power was not being developed. I leveled the wings and lowered the nose as I worked the throttle several times. I believe I took the carburetor heat off after I added power, but I don't specifically remember.

"I realized I was going to hit the water, so I began a roundout. Because the water surface was extremely smooth, the water was clear, and the sun was bright, I hit before I expected to, without having the aircraft completely rounded out or slowed to stall speed. I don't remember warning the observer or having time for emergency procedures.

"The next thing I remember is being out of the

aircraft and swimming, greatly aided by my flak vest. I looked for my observer and, not seeing him, made several attempts to dive to the aircraft and get him out. I was unable to find it. I was in the water approximately 20 minutes before a fisherman pulled me in his boat. . . ."

The pilot was thrown from the aircraft with his helmet and vest intact. Momentary unconsciousness resulted and his vest kept him buoyant until he regained consciousness. The observer, who was not wearing a helmet or vest, was knocked unconscious and drowned.

Cause factors:

"1. Spatial disorientation, including loss of depth perception, resulting from low-level flight over smooth water, and a change of visual reference.

"2. Firing rockets at unauthorized targets.

"3. Supervisory error in the apparent laxity in both unit flight standardization and flight safety programs."

Reviewing official:

"While all three of the stated causes did contribute to the accident, the proper summation of these should have been pilot error. The aviator displayed a lack of judgment and maturity when he considered firing at this type of target.

"Medical reports indicate that the most probable cause of death of the observer (drowning) was the head injury. This may have been prevented had the observer used the available flight helmet. All pilots of this command have been instructed to refuse to fly an observer who will not comply with established safety policies."

". . . fatigue most definitely played a role in this accident"

Very Tired Firefly

UH-1D aircraft commander: ". . . I picked the aircraft up to a hover and made a normal takeoff with my searchlight and landing light on. My running lights were also on. When we were airborne at an altitude where the lights were not needed, I switched them off and looked to my left and up for the lead gunship's beacon. I noticed my heading was 150° so I initiated a turn to 180°. Then I looked back inside to make a crosscheck and saw 60 knots on the airspeed indicator. Then we were tumbling through the water. There was no indication or sound from the pilot or the crew that we might be in an unusual attitude.

"We tumbled through the water and then began to sink. I felt myself being pulled down. I was in a panic, clawing and struggling to free myself and rise to the surface. During one calm moment, I reached down and unsnapped my seat belt, then kicked and swam upward. There was a fuel fire on the surface, but I was away from the edge of it. I stayed close to the wreckage, except when the fire began to spread toward me. . . .

"I began to look for the closest shore to swim to, but then I saw the boats with searchlights coming towards the wreckage, so I stayed where I was. During the time I was in the water I saw no one surface and heard no one calling. I must have been in the water about 5 minutes before I was picked up and brought to the first aid shack."

The helicopter was functioning as the light ship for a firefly mission. It crashed at 0002 and the pilot and four crewmembers were killed.

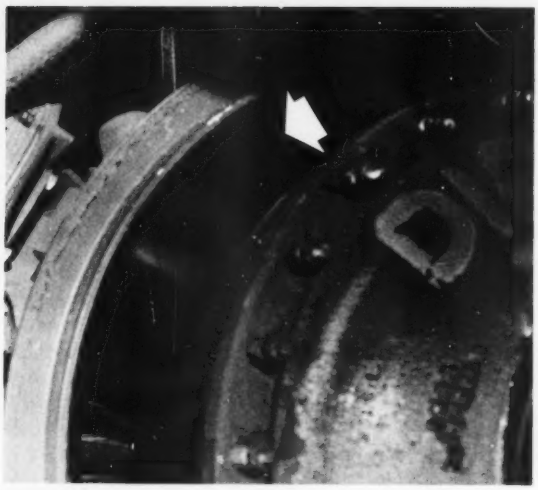
Flight surgeon: "From studying the data, it becomes apparent that the accident resulted from disorientation on the part of the aviators. The aircraft commander states that no mechanical failure occurred. He told of looking up and to his left to see one of the gunships, and recalls noting the rotating beacon. Within 3-4 seconds after that, he flew into the water. The pilot made no overt action to indicate that he noted any unusual attitude or hazardous instrument change. . . .

"I personally feel that fatigue most definitely played a role in this accident. The pilot had flown 8½ hours on the preceding day, completing that mission at 1800. He then flew on 'firefly' that night at 2145, logging approximately 1 hour and 45 minutes before the accident. This was the pilot's first firefly mission and he was carried to give him training.

"Some 45 days prior to this accident, a letter was sent to all our supported units from this detachment, advising them that we felt a fatigue hazard existed when men were required to fly the day before or after a 'firefly' mission. All commanding officers agreed. . . .

"SOP for 'firefly' missions is for the man in the left seat to monitor the instruments and the man in the right seat to fly the aircraft. We can suspect that if the pilot was fatigued, he possibly was not completely cognizant of what was occurring on the instrument panel."

Statement of reviewing official: "In this case, supervisory error is established since the pilot had flown 8.30 hours during the day, 1.15 hours on the night mission, and had the accident not occurred, probably would have flown an additional 4 hours to complete the mission — a total of 13.45 hours. Commanders and operations personnel have been instructed to closely monitor the flying hours to ensure aviators are not scheduled for night missions after having flown a reasonable number of hours during the day."



Dirt clogged vanes cutting off airflow

DIRTY ENGINE

UH-1D aircraft commander: ". . . The aircraft was loaded with approximately 800 pounds of cargo, two passengers, and 600 pounds of fuel. I hovered to the south end of the soccer field to get a run at some 20-foot wires about 125 yards away. The wind, judged from a flag in the field, was about 10 knots and variable. I positioned the aircraft to get the longest run at the barrier, heading in a northwest direction into the wind.

"The aircraft hovered at 6600 rpm and I started my takeoff. During takeoff, the rpm dropped to 6000 and the aircraft accelerated to about 25 knots. We were about 30 feet high, approaching the barrier, when it felt as if the aircraft was settling. I made a slight pitch pull and cyclic flare and the aircraft cleared the barrier.

"At this point the aircraft went into a definite settling condition, which I thought might have been caused by a wind shift. Because of further barriers to the right and in front of the aircraft, I turned to the left. The aircraft continued to settle and I pulled collective, attempting to clear the barriers, but we crashed on a slope about 150 yards from the takeoff point. There were no injuries."

Analysis:

"Inspection of the engine showed that all power vanes were missing from the N_2 turbine. When the engine was disassembled under the supervision of a technical representative, it was discovered that the N_2 coupling and through bolt were sheared as a result of sudden stoppage of the rotor system on impact, and that the N_2 turbine damage was a result of the same action. Engine damage was a result, rather than cause, of the accident.

"Intake and air vanes in the compressor section were coated with glazed dirt as far back as the second stage. This condition existed despite the fact that the engine was only 92 hours out of major overhaul and this was the first day of flight after a periodic inspection. It reduced the engine power to a point well below that normally available, and reduced the span of power normally found at the higher N_1 readings.

"The technical representative stated that this condition would lower the maximum power output of the engine by 3-4 pounds of torque. It would also cause a much faster than normal decay of N_2 rpm when full power was being used. The aircraft commander could reasonably expect to have more power reserve than was the case. He knew that he had a relatively light load and ignored the symptoms that his engine was overloaded under the conditions. This should have been obvious to him when the rpm bled off in the course of a normal takeoff.

"Investigation failed to reveal a satisfactory answer as to why the aircraft settled toward the wires after translational lift had been attained. The only answer offered was a sudden wind shift. Shifts of this nature and magnitude are common in the area of the crash and there is no reason to doubt that this occurred. However, the investigator felt that, under normal circumstances, this would not have caused as much loss of lift as the pilot experienced."

Findings:

The helicopter was released from periodic inspection with an excessively dirty engine.

The aircraft commander took off with no margin for error or emergency.

The go-no-go placard was not updated at the last periodic inspection. Had the placard been updated, it probably would have provided information for corrective measures which may have prevented the accident.

It was recommended that all pilots be cautioned that draining of rpm during takeoff indicates that the engine is overloaded *for the conditions,* regardless of load, and the load should be reduced, even if an aborted takeoff is required to accomplish this. It was also recommended that commanders require responsible maintenance supervisory personnel to inspect aircraft engines and other critical components for cleanliness after they have been inspected following intermediate and periodic inspections.

. . . all of you, at one time or another, have been dusted off by that big Chinook . . . you're certainly aware of the dust and dirt it blows around, for I see other pilots run for cover when we approach or take off . . .

WOULD YOU FLY into or around a known hurricane or tropical storm? Of course you wouldn't. No one with any air sense or just plain common sense would. But you are doing it nearly every day. Immediately, you go on the defensive

From EAGLE SAFETY, 17th Combat Aviation Group

THE HURRICANE

CW3 John G. Daneker

and are ready to dispute this accusation. How many times have you intentionally operated your UH-1 in proximity to a CH-47 which had its rotors turning? Thinking back, it has been quite a few times, hasn't it?

I know all of you, at one time or another, have been dusted off by that big Chinook. If you haven't, you certainly are aware of the dust and dirt it blows around in an area, for I constantly see other helicopter pilots run for cover when we approach or take off. If you don't make it, or the cover afforded little protection from the blowing dust, dirt, gravel, rocks, tin cans, etc., you stood up, shook your fist at us, swore, and said you were going to make recommendations that we be moved out of the area. This is good. At least, in one sense, you know that we're windy.

But 15 minutes later, while we're attempting to pick up or drop off an external load, you intentionally operate your helicopter in the immediate vicinity where we're working. I know all of you have either experienced the severe turbulence we create or heard other pilots discuss it. We try to avoid other aircraft and personnel whenever possible. But there is nothing we can do when someone comes in too close to us while we are sitting on the ground with rotors turning at flat pitch.

At a distance of approximately 60 feet from the Chinook, our downwash is in excess of 50 knots; at 100 feet, it diminishes to 40 knots. It can be easily understood why a Huey pilot has problems putting his aircraft down within 100 feet of us. I have seen, on numerous occasions, a Huey hover to within 75 feet and attempt to set down at the refueling point. The gyrations that helicopter went through! I wouldn't blame the crewchief if he jumped out. What makes it so bad is that 200 feet away is another refueling hose where the elements are more in your favor.

We really cringe in our seats when we're attempting to pick up or drop off external loads and you come whipping in. While at a 15-foot hover (aft gear clearance) and, either picking up the load or setting it down, the rotorwash created is well in excess of hurricane (75 mph) force. At a distance of 75 feet, the rotorwash can be well in excess of 100 knots, depending on the gross weight. It will always be in excess of 75 knots at this distance.

It can easily be seen that to operate any helicopter, Huey or Chinook, in and around this area is going to require the best pilot technique possible. So why tax your capabilities in this manner? Why take the chance of having a loss of lift or control and settling to the ground with damage and the loss of combat effectiveness for all concerned?

We know you are on our team. We drink together in the bar, eat together in the mess, and swap lies in the shower when the water is on. Where we don't seem to get along too well sometimes is when we are in our machines. We work pretty well together when the going gets tough. Your guns are a great comfort when Charlie is around. We give you a lift once in a while when your power fails you. But when we are both working at jobs for different people is where the trouble usually comes.

First, we work on one radio frequency and you on another. We don't know what you are doing and I doubt you are too certain what we're up to. We do our best to keep out of your way as much as we can. But sometimes we could use your help. One place is in the fire base. Usually there is only one small area where the ground commander will let us put our loads. They don't like to get blown around either. If you could possibly find some other area to park your bird, we wouldn't cringe every time we start banging your tail rotor against the stops.

If you have to park close by, at least you could tie that main rotor down. We haven't much choice. We have to dump our load where they want it. If you are off somewhere getting the hot poop for your next mission you are mighty hard to locate. It costs $50 and 25 gallons of fuel every time we circle 5 minutes waiting for someone to tie down your blade. Often, we don't realize that the blade is not secure until it's too late. Then it flops up and down, banging on the stops. You're the guy who has to fly it the next time. I sure wouldn't want to.

Another time you could help is when we are landing or taking off. Thirty-three thousand pounds of Chinook is a might slow to react on sudden emergencies. When it does react fast, the situation usually gets worse instead of better. If you see us coming or going, please give us a little room. If you are in a bind, give us a call on channel 19 or 20 and we'll do our best to give you all the room you need. Often if we just know you are around, it helps a great deal. But you seem to like those treetops so well that we just don't see you until it's too late.

Say, don't forget about that jet blast. Those twin Lycomings sure warm up the air back there, If you come hovering by with a heavy load and all of a sudden the temperature goes up 20°, I doubt that you'll be able to keep it going too well.

We are really easy to get along with, but we admit we sure are a windy bunch. We'll be glad to help you when we can. However, if you would try to help yourself a bit, it sure would give us a break. We really would hate to lose any of you.

pearl's

Personal Equipment and Rescue/Survival Lowdown

Dear Pearl:

Having read your article concerning the new NOMEX fire retardant flight suit in the September issue of the AVIATION DIGEST, my mind has been striving to reach an answer about how we, as a company, could obtain such safety garments.

Several days ago, one of our aircraft crashed due to suspected engine failure. On impact, it caught fire. The aircraft commander sustained burns over 75 percent of his body and the crewchief over 30 percent of his body. The pilot and other crewman were burned to death. It was quite evident that the cotton fatigues they were wearing furnished little, if any, protection from the fire.

I'm sure the other aviators in our company would be willing to take the necessary measures for procuring flight suits that might save them from severe, if not fatal, burns. I would appreciate any information possible concerning the NOMEX flight suit. . . .

name withheld

Dear Pearl:

. . . Of late, I have heard much about this new NOMEX flight suit. However, I have yet to see one in service at. . . . My question is, how do I get one to wear? . . .

Another question that comes to mind is: Will this flight suit be the standard uniform for flight duty, or will we continue to wear various uniforms, depending on the type of mission performed or where we are stationed? It would seem that safety should be the first requirement of the uniform worn. . . .

A lot of information about the fire retardant qualities, the comfort, and how to wear this new flight suit has been released through this and other aviation publications. However, I still don't know when I can anticipate wearing it. At the moment, I am flying in the fatigue uniform which, as we all know, has little or no fire retardant qualities. I do wear gloves and combat boots while flying, but I would like to give the rest of my body some protection from fire. . . .

With a little pressure from the right people in the right places, we can remedy this situation now. The individual aviator can do his part and so can the people in the command section, by making policy and enforcing this policy. A good example of this is our flight suit situation. Some of us wear flight suits, others wear fatigues, while still others wear khakis or the Army green uniform. Maybe this NOMEX flight suit will settle the issue. I certainly hope so. We need a standard flight uniform that is safe and serviceable for all situations and assignments in Army aviation. . . .

CW2 Edward G. Turner

Hi Pearl:

. . . I am the S-4 sergeant of our unit and would like to know if you have the stock number and correct nomenclature for the NOMEX flight suit, as well as the authority. I spoke to our G-4 about this and they know nothing about the item. I understand that at present there are some in the command and a couple of thousand more on the way. We have had our fair share of crashes over here and would certainly welcome an item such as this. Any information you can provide will be greatly appreciated.

SSG Martin Mathis
227th Avn Bn. (AH)

Dear Pearl:

Please send me the FSN of the new NOMEX flight suit. There are supposed to be several thousand of the suits in Vietnam but I am unable to find an FSN anywhere.

Your story in the September issue of the AVIATION DIGEST was very interesting and the photos as well. . . .

CPT Conrad W. Davis
178th Assault Support Helicopter Co.

Pearl:

We are National Guardsmen and we have found out that we will burn also. Are the NOMEX flight suits available to us? If so, can you tell us the FSN for the various sizes and their costs? We need sizes from skinny-short to fat-long.

. . . We are in the process of procuring new aviator flight gear and this is the best time for us to order the latest equipment. Thanks large.

MAJ Russell C. Hall
Arizona Army National Guard

merry Christmas
MERRY CHRISTMAS

pearls

Gentlemen:

I wish I could tell you that the NOMEX flight suits are available and give you federal stock numbers for procurement. However, it appears that these suits will not be available outside of USARV for some time to come. According to the latest information available, an ENSURE request from USARV for manufacturing 34,450 two-piece NOMEX flight suits has been approved. Mr. Fred Miller, a representative of the Dupont Company, visited this organization 1 September 1967 and stated that the contract had been awarded Dupont for the NOMEX material to fill the USARV request. This material will be delivered to the Defense Supply Agency at the rate of one-third of the total yardage per month, beginning on or about 23 October 1967. The Defense Supply Agency will manufacture the suits and Mr. Miller stated that he felt certain the last of the suits would be finished by late January 1968.

The Department of the Army TWX message approving the USARV request also stated that funds would be provided for the manufacture of 200 NOMEX flight uniforms to be employed in engineering and service tests.

In the interim, until permanently fire retardant flight clothing is available to all aviation personnel, I recommend the following process be used for the flight clothing you are now wearing.

PEARL

FIRE RETARDANT PROCESS

The orange flight suit is fire retardant when issued new, and remains fire retardant until it is laundered approximately 14 times. The orange flight suit, the gray KB-2 flight suit, and fatigue uniforms can be treated by the following process:

1. Clean flight suit or fatigues by washing with detergent; damp dry, using spin cycle.
2. While still damp, submerge and agitate 10 minutes at 100° F in the following solution:
   - 6 gallons of water
   - 2 pounds of borax (FSN 6810-264-9056)
   - 1½ pounds of boric acid (FSN 6750-174-5454)
   - 1½ pounds of ammonium phosphate, dibasic (FSN 6810-264-6547)
3. Hang to dry or iron with warm iron (250° F). Do not dry in automatic dryer.

Fire retardant qualities are lost with each washing and must be repeated.

Dear Pearl:

I read your article, enjoyed it very much, and found it most informative. In the June issue, you were giving information about a new survival kit. . . . What I would like to know is, can you supply me with details on this kit, such as illustrations and a list of contents? Any information on makeup and contents of individual survival kits will be greatly appreciated. . . . Looking forward to many more of your articles and thanking you in advance, I am,

LaVere Halsey
Lemon Grove, Calif. 92045

Dear Pearl:

In regard to your article in the June issue, showing colored photos on the new survival kit for Army pilots in Vietnam, please send me, if possible, a complete description, breakdown, and inventory of the articles in this kit. . . .

Albert A. Marty, Jr.
Sacramento, Calif. 95818

Gentlemen:

At right is an illustration of the individual survival kit with a component list and the location of each item in the kit, as well as information about the medical items.

Here's another tip about the wire saw contained in the kit. It can be used to cut easily in any direction, but there are several things you should remember about using it.

Keep the saw taut. You can do this if you use one arm as tension as the other arm is used to pull the saw for cutting; then reverse arm actions. With a little practice you can become as skillful as a surgeon. Use short strokes and only as much of the blade as necessary. Don't put your saw in a bind and use heavy pressure, as this may jam and possibly kink or even break the saw. The saw will cut wood, metals, and can be used for cutting up game.

PEARL

Dear Pearl:

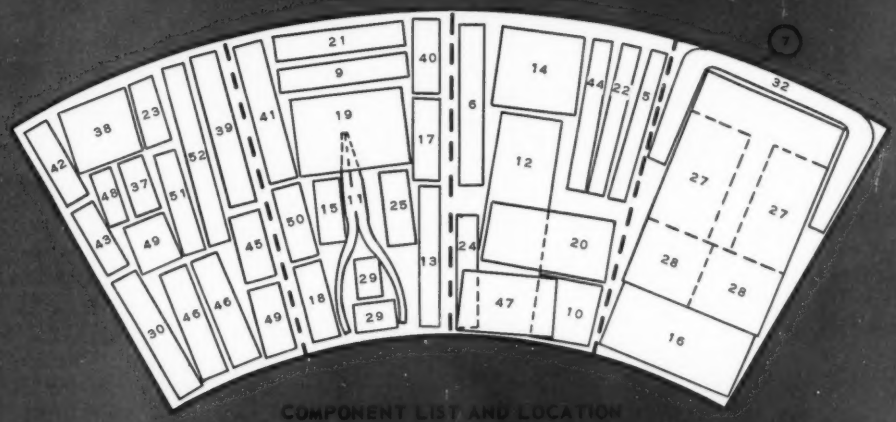
My unit has received four survival kits, cold climate, FSN 8465-082-2512. We have been unable to locate the manual or manuals which cover the maintenance and inspection requirements for the kits. Request that you supply us the number of the applicable publications for this survival kit.

SP6 Robert M. Smith
42nd Trans Co

Dear SP6 Smith:

The publication you refer to is TM 55-8465-206-13, "Organizational and DS Maintenance Manual for Survival Kits, Army Aircraft," dated December 1966.

PEARL



COMPONENT LIST AND LOCATION

1. Lid assembly (not shown)
2. Container assembly, lower (not shown)
3. Mirror assembly, signal (in pocket on item 2)
4. Bag, water storage (over item 7)
5. Blade assembly, knife
6. Blade assembly, hacksaw
7. Base, component packing
8. Flare projector and 4 flares (in pockets on item 2)
9. Waterproof matches and synthetic flint
10. Firestarter sheets and tinder
11. Needle nose pliers
12. Aluminum foil
13. Sewing kit
14. Wire saw
15. Wrist compass and strap
16. Nylon cord
17. Fishing kit
18. Fishing line
19. Mosquito head net and mittens (compressed)
20. Compressed sponge
21. Flashlight and lanyard
22. Candle
23. Toothbrush and dentifrice
24. Snare wire
25. Plastic whistle and lanyard
26. Instruction booklet and pencil (in pocket on item 34)
27. Salt and pepper
28. Chili powder
29. Bouillon cubes (4)
30. Waterproof receptacles
31. Solar still
32. Plastic tubing (4 ft.)
33. Bag, carrying (not shown)
34. Survival, holster (not shown)
35. Knife, hunting, sheathed (in pocket on item 34)
36. Card—instructions and components (in pocket on item 34)
37. Antiseptic soap
38. Elastic gauze bandage (2" by 5 yd.)
39. Sun and bug repellent (1 oz. tube)
40. Water purification tablets (50 tablets)
41. Adhesive bandages (5)
42. Adhesive tape (1" by 1 yd.)
43. Eye ointment (1/8 oz. tube)
44. Antibiotic ointment (½ oz. tube)
45. Anti-malaria tablets (3)
46. Pain killer capsules (12)
47. Anti-diarrhea tablets (12)
48. Stay awake tablets (10)
49. Salt tablets (20)
50. Anti-infection tablets (12)
51. Tweezers and safety pins
52. Reflective chalk (2)
53. Light, marker, distress (in pocket on item 34)

MEDICAL INFORMATION

PAIN KILLER CAPSULES: Use for headaches and acute pain. Take one capsule every three hours. No more than 6 capsules in 24 hours.

SALT TABLETS: For excessive sweating take 1 or 2 tablets with a drink of water. Use 4 to 6 times daily as needed. Swallow whole.

ANTI-INFECTION TABLETS: For fever, infection, diarrhea, take 1 tablet every 4 hours.

WATER PURIFICATION TABLETS: Not for use with salt water. Add 1 tablet for each quart of clear water, 2 tablets for each quart of water if not clear. Wait 5 minutes, shake well, wait 10 minutes before using for any purpose. For very cold water wait 20 minutes.

EYE OINTMENT: In case of inflammation or foreign body which cannot be easily removed, squeeze a small amount of ointment on inner surface of lower lid, apply 2 or 3 times a day. **CAUTION: DO NOT RUB EYE.**

ANTIBIOTIC OINTMENT: Apply to minor cuts, wounds, burns and abrasions once or twice daily, and cover with dressing.

ANTI-MALARIA TABLETS: Take 1 tablet weekly to prevent Malaria. Take with or after food. Swallow, do not chew.

STAY AWAKE TABLETS: To keep awake take 1 tablet every 12 hours.

ANTI-DIARRHEA TABLETS: For diarrhea take 2 tablets 3 times a day.

From ROTOR BREEZE,
Bell Helicopter Company

THE TA FUEL CONTROL: ITS OPERATION

BEFORE DISCUSSING the operation of the TA Fuel Control, a few basic operating principles of jet engines — and particularly the Lycoming T-53 turboshaft engines — should be reviewed. In other words, let's discuss how a jet engine runs and then we can see how the fuel control operates to let the engine run this way.

Very simply, air enters the front of the engine and is compressed by the compressor. Fuel is then added to the compressed air and the air-fuel mixture is burned in the combustor. As the mixture exits from the engine, the hot gases pass across and rotate both the N_1 and N_2 turbine wheels.

The power from a jet or turboshaft engine comes from the energy released when the fuel is burned in the combustor. Part of this power is used to rotate the N_1 turbine wheel. The N_1 takes only the power needed to drive the compressor to which it is attached. Most of the remaining power is used to rotate the N_2 turbine wheel. The small amount of power remaining escapes out the tailpipe as jet thrust. The power being used to rotate the N_2 wheel will, of course, be the output power of the T-53 engine since the N_2 shaft drives the aircraft rotor system.

Now, how can we tell how much power the engine is putting out? Is there a simple way to measure it? Well, where does the power come from? From the fuel burned, and to burn fuel we need air.

Most helicopters are not instrumented to measure the amount of fuel being burned, but they are instrumented to measure the amount of air being burned. The amount of air being taken into the engine and burned will depend on the rotational speed of the compressor. The faster it goes, the more air is taken in, the more fuel is added and burned, and the more power we have available in the combustor. Of course, the N_1 turbine wheel takes some of the power to drive the compressor but the rest is taken by the N_2 wheel to drive the aircraft rotor system.

So, if you don't think you have the correct power, check your N_1 speed.

To get good performance from a gas turbine engine (no hot starts, no surging or stalls, no flameout, fast acceleration, correct power), the amount of fuel added to the air in the combustor must be exact. If too much fuel is added (excessively rich mixture), we get hot starts, surging, stalls. If too little fuel is added (excessively lean mixture), we'll get no starts, or flameouts. In an automobile engine, the adding of fuel to the air is done in the carburetor. In a jet engine, the adding of fuel is done by the fuel control.

Now, if the fuel control is to add the correct amount of fuel to the air in the combustor, it must know how much air there is in the combustor at all times. How does it know this? Previously, we said the amount of air in the combustor depended on the speed of the compressor. So we tell the control the N_1 or compressor speed. Now, a very important point: The amount of air in the combustor will not only depend on the speed of the compressor but it will also depend on the condition of the air as it goes into the compressor. And the condition of the air depends on its temperature (T_1) and pressure (P_1).

On a hot day, air for a given volume expands and weighs less. On a cold day, it contracts and weighs more. This illustrates the temperature effect. As you go up in altitude, the atmospheric pressure decreases and air weighs less — the pressure effect.

So we must not only tell the fuel control the compressor speed, we must also tell it the temperature and pressure of the air as it goes into the compressor.

The job of the fuel control is to take the three signals supplied above (N_1 speed, inlet air temperature and pressure) and supply the correct fuel flow to the engine for either acceleration, deceleration or steady state engine operation. The pilot, by moving the collective in the cockpit, tells the fuel control whether acceleration, deceleration or steady state engine operation is required.

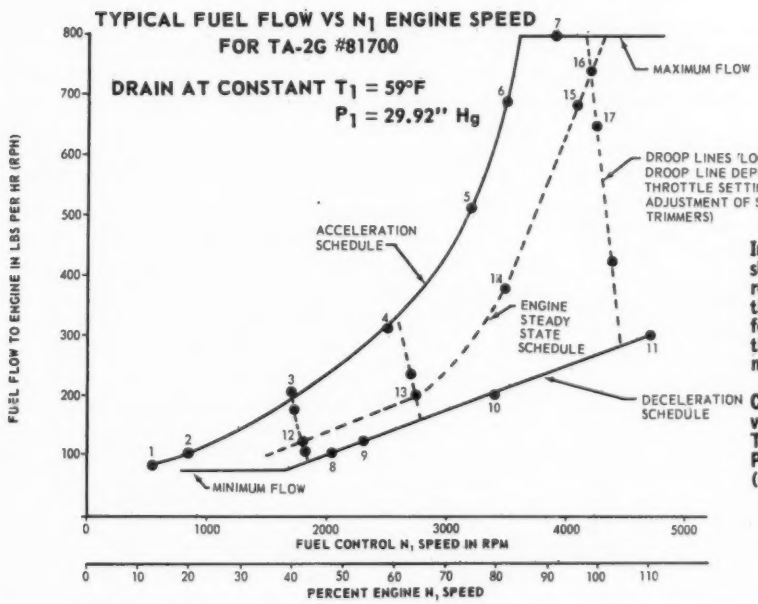
The fuel control causes the engine to accelerate by supplying a rich fuel/air mixture and decelerates by supplying a lean fuel/air mixture. Let us take an example of how this works — the engine is at low power and the pilot wants to go to military power. The pilot first signals the fuel control that military power is required by moving the collective. The control then schedules a rich mixture to the engine to allow it to accelerate. As the N_1 speed increases and approaches military power, the fuel control adjusts the mixture from rich to the normal mixture required for steady state operation at military power.

The reverse is also true if the engine is at military power and the pilot wants to go to low power. In effect, the pilot moves the collective for the power he needs and the fuel control automatically gets him there.

Briefly in review:

- A "normal" fuel/air mixture allows the engine to run at a constant speed. It will neither speed up nor slow down.
- A "rich" mixture will cause the engine to accelerate.
- An "excessively rich" mixture will cause engine surge, stall, and hot starts.
- A "lean" mixture will cause the engine to decelerate.
- An "excessively lean" mixture will cause engine flameout.

The preceding explanation of the engine/fuel control relationships in term of N_1 speed, T_1 temperature, P_1 pressure, cockpit collective position, excessively rich, rich, normal, lean, and excessively lean fuel/air mixtures may seem too simple and basic. Yet, a clear understanding of them is absolutely essential if fuel control operation is to be understood.



In the accompanying graph curve #1 shows the fuel flow vs N_1 engine speed relationship for the TA control as used on the T53 engine. While this curve is drawn for the TA-2G Control #81700 as used on the T53-L-11 engine, it is typical of all model TAs.

Curve #1 is drawn to show the fuel flow vs N_1 speed relationship at a constant T_1 temperature of 59° F and a constant P_1 pressure of 29.92 inches of mercury (standard day).

THE TA FUEL CONTROL

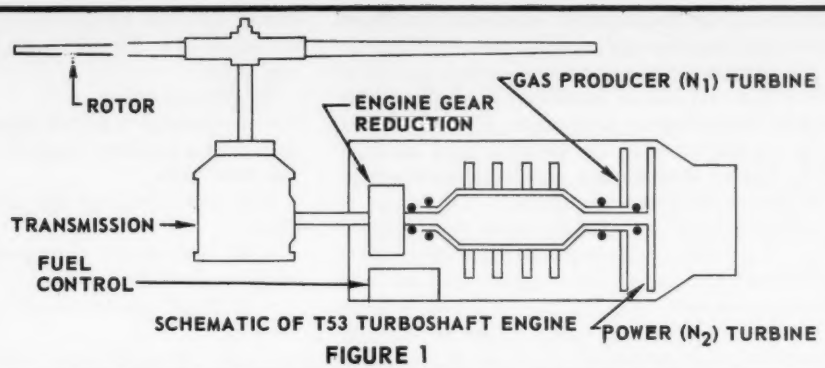


FIGURE 1

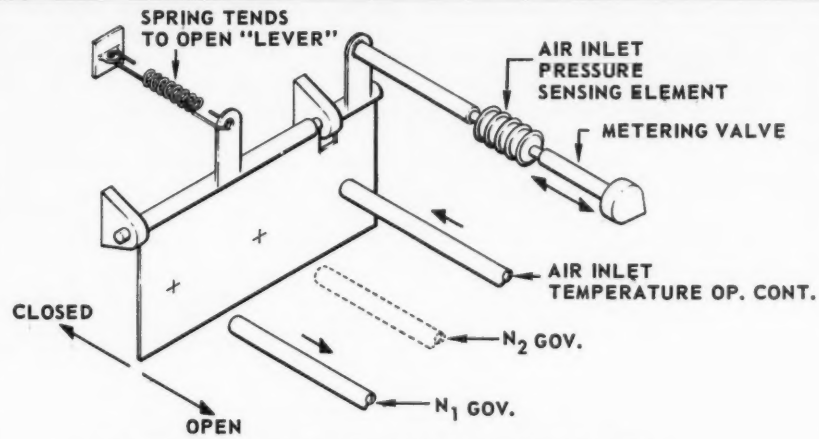

SPRING TENDS TO OPEN "LEVER"
AIR INLET PRESSURE SENSING ELEMENT
METERING VALVE
AIR INLET TEMPERATURE OP. CONT.
CLOSED
N_2 GOV.
N_1 GOV.
OPEN
IN THIS CASE, THE N_1 GOV. CONTROL WOULD PERMIT THE "LEVER" TO OPEN, BUT THE TEMPERATURE OPERATED CONTROL OVERRIDES IT.
SCHEMATIC OF CAM FOLLOWER LEVER AND CONTROLLING DEVICE

FIGURE 2

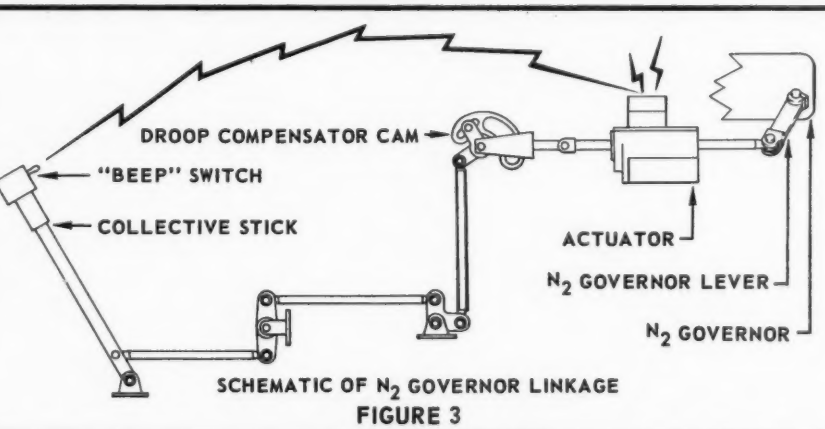


FIGURE 3

In explaining the control, it is best to follow the sequence of operations that the helicopter would usually go through, from the starting of the engine on the ground to the shutdown of the engine after the helicopter has landed.

When the pilot presses the starter switch, it operates the spark ignitors and a solenoid. This solenoid opens the starting fuel valve, allowing fuel to flow to the primer nozzles.

The purpose of the primer nozzles is to furnish an adequate amount of fuel to the spark ignitors to heat the combustion chamber to a point where it will maintain fuel combustion without requiring continued energizing of the spark ignitors.

The primer nozzles are separate from the main fuel nozzles, but both sets of nozzles receive fuel from the same dual-element pump, which is driven by the gas producer turbine. This pump is essentially two pumps and during normal operation, each pumps part of the fuel. The capacity of each element is such that in case of failure of one element, the other can supply the fuel required.

As the pilot continues to press the starter switch, fuel flows to the primer nozzles, but fuel will not flow to the main fuel nozzles until the fuel pressure has reached a minimum allowable value established by the foot valve. When adequate combustion is established, the pilot releases the starter switch, shutting off the ignitors and the flow of fuel into the primer nozzles.

During engine starting procedures, the pilot is primarily concerned with gas producer speed (N_1) and exhaust gas temperature. His influence on N_1 is introduced through the twist grip. If he holds a constant twist grip position, N_1 will accelerate to the limit established, then remain constant. If he changes the twist grip position, N_1 will change to coincide with the new position and then remain constant. The twist grip controls the fuel flow in this manner through the main metering valve, which actually meters out the fuel.

At this point, we first encounter the main fuel control. When the twist grip demands a constant power, it is in effect signaling the N_1 governor to accomplish this. If external factors tend to cause N_1 to change, the pilot will never be aware of it as the hydro-mechanical computer will return N_1 to the value he has requested before any change becomes visible on his instruments.

If the metering valve were connected directly to the twist grip so that the valve would open and close as rapidly as the twist grip demanded, as during manual operation (explained later), there would exist a great possibility of the engine's receiving too much fuel and "overtemping" or encountering compressor stall or not enough fuel and causing a flameout. Instead, when the twist grip demands an increase in N_1, the metering valve starts to open, but the limiting factors which are controlled by engine inlet air pressure, engine inlet air temperature and N_1 governor, override the twist grip signal and control the opening of the valve.

The limiting, or overriding factors tend to maintain a proper fuel flow to prevent failure of, or damage to, the engine. When the twist grip demands a decrease of N_1, its signal is ordinarily overridden by the pressure operated control and the N_1 governor to control the closing of the valve and prevent the possibility of a flameout.

It may be asked how the control can change so readily from one set of controlling factors to another. Attached to the valve by a linkage system is a cam follower lever which tends to open the main metering valve.

However, as previously mentioned, there are devices to prevent the lever from opening the valve, these devices being the N_1 governor and the temperature operated control. The device which holds the lever most fully closed will control the flow of fuel.

For instance, at constant N_1, the N_1 governor will have control because the lever touches against it before the lever can touch against the temperature operated control. Likewise, during acceleration, the temperature operated control will have control because the lever touches against it before the lever can touch against the N_1 governor (see fig. 2).

During deceleration, the lever is usually held closed by the N_1 governor and not the temperature operated control. It may be important to mention at this time that both the N_1 governor and the temperature operated control influence the lever through a common three-dimensional cam which permits one factor to override the other. Inlet air pressure influence is introduced into the linkage between the cam follower lever and the fuel metering valve, with the result that pressure affects the fuel flow at all times (see fig. 2).

There is another aspect to gas producer deceleration which must be considered. A minimum fuel flow must be maintained to prevent engine flameout. A deceleration lever, which is positioned by N_1, is located at a different point on the linkage system from the cam follower lever. The deceleration lever serves as a device limiting the cam follower lever movement in the opposite direction; that is, it prevents the main fuel metering valve from closing too far. If the N_1 governor, pressure

THE TA FUEL CONTROL

and temperature operated controls tend to move the linkage too far in closing the valve, the linkage will be stopped by the deceleration lever.

To sum up the effects of the devices which control the position of the main fuel metering valve, that device which permits the least fuel flow will be the controlling device. The one exception, of course, is the deceleration lever which maintains at least a minimum flow. This should be kept in mind as we continue to the next phase of helicopter operation.

Although the pilot first controls the engine according to gas producer speed, this will not be the main controlling factor throughout the majority of the helicopter's operation. The engine must be controlled to maintain a constant power turbine speed (N_2) in order to maintain a constant rotor speed. This is the reason the fuel control of the T-53 contains a power turbine governor.

For flight operation, the pilot turns the twist grip to full open. Then he presses the N_2 governor "beep" switch to obtain the N_2 that he desires. This switch operates the actuator to position the N_2 governor lever and is located on the collective stick. As he raises the collective stick, N_2 is governed to remain constant, even though the rotor blades are requiring more power (see fig. 3).

By pressing the N_2 governor switch, the pilot selects the speed for the governor to maintain. The N_2 governor acts on the main metering valve just as the N_1 governor did.

At this point, we encounter a familiar item in our study of the fuel control system — the cam follower lever. Here again it is prevented from opening the main metering valve too far by another device, this time the N_2 governor. The way in which N_2 becomes the limiting factor on the main metering valve goes back to the situation where the pilot turned the twist grip to full open. Remember that the device which permits the least amount of fuel flow will be the limiting device on the system. By turning the twist grip fully open, the N_1 governor is eliminated from controlling fuel flow because it would permit a greater fuel flow than N_2. Therefore, N_2 takes its place in positioning the valve.

In normal cruise or hovering flight the N_2 governor is controlling power turbine and rotor speed. If the flight condition is on or near maximum power and the collective pitch is increased, the rotor speed will decrease. The N_2 governor will sense the condition and increase fuel flow to maintain rotor speed. However, it will be unable to do so and main rotor speed will decrease, requiring the pilot to reduce pitch. The N_2 governor was overridden either by the maximum fuel flow stop or by the 3-D cam, which acts as a computer, sampling air temperature and pressure and N_1 speed. Except for this upper power limit, the N_2 governor is in command of the engine under normal powered flight.

Assume we are in a low-power descent, approaching for a landing. Although rotor rpm may be correct and N_2 power turbine speed likewise (not a "needle-split" autorotation), compressor speed N_1 may be quite low. Near the ground the pilot raises the collective pitch to check his descent. Rotor speed starts to fall off slightly and as a result the N_2 governor calls for more fuel flow. N_1 compressor speed then increases, resulting in more power. But the process may take several seconds because the fuel control will limit the rate of increase of fuel flow (asked for by N_2) according to an acceleration schedule. This limitation is necessary to avoid compressor stall or overtemping and is accomplished by the hydromechanical computer (3-D cam, etc.) of the fuel control.

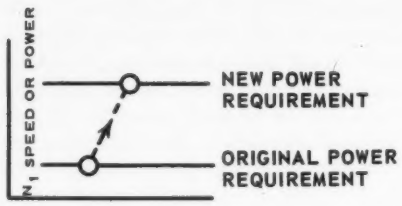
Ideally, the N_2 governor should maintain a constant N_2. However, this governor must be designed in such a way that when more power is required through the raising of the collective stick, the N_2 speed for this power will be somewhat less than what it was before additional power was requested. This is to prevent it from overshooting the new value of N_1 necessary for the new power requirement. If this overshooting should occur, the result would be a hunting condition which would further result in violent vibrations caused by rapid acceleration and deceleration of the engine (see fig. 4A).

However, helicopter performance requires a constant rotor speed. This drop in N_2, commonly known as "droop," would mean a reduction in rotor speed, which is unacceptable. To prevent this, a droop compensator is built into the system which is mechanically connected to the collective stick (see fig. 3). A properly rigged system changes the N_2 governor lever position to maintain a constant N_2 speed during power requirement changes (see fig. 4B).

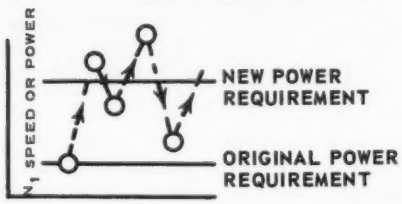
The same situation applies when the pilot is operating according to constant N_2 as when he was operating according to constant N_1. If he has the twist grip fully open, all he has to do is set the N_2 governor with the "beep" switch to maintain a particular N_2. He can move the collective stick up or down and the N_2 governor and droop compensator together will keep N_2 constant, except for a

momentary "transient droop" which is normally experienced in helicopter operation when the collective stick is raised at a normal rate or faster.

In the event that the automatic control malfunctions in such a way as to cause an overspeed of N_2, the pilot has two alternative methods of regaining control of N_2. The most common method is to first roll-off the twist grip, which partly closes the metering valve to prevent a sudden surge of fuel from entering the engine, and then switch to the emergency system by flipping the pilot selector switch to emergency. This switch operates a solenoid which causes the fuel to bypass all automatic control. Fuel flow is then controlled by the twist grip in much the same manner as the flow of water from a faucet is controlled by the faucet handle. Instruments must be closely monitored and care must be taken to prevent overspeeding, overtemping, or flameout of the engine when using this method of control.

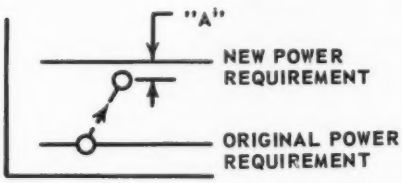


IDEAL GOVERNING . . . .

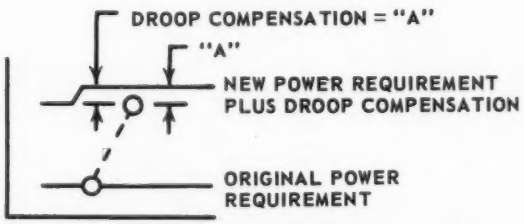


WOULD ACTUALLY RESULT IN OVERSHOOTING

FIGURE 4A



A GOVERNOR WITHOUT DROOP COMPENSATION DOES NOT OVERSHOOT BUT LACKS SUFFICIENT POWER . . . .



. . . WHILE A DROOP COMPENSATED GOVERNOR DOES NOT OVERSHOOT, YET PROVIDES CORRECT POWER

FIGURE 4B

The alternative and preferred method of control in the event of an N_2 overspeed is to roll-off the twist grip and regain control of N_2 without switching to the emergency system. When this is done, the N_1 governor again controls the fuel flow, just as it did when the engine was being started. It is important to note that when the pilot is controlling the engine in this manner, he does not have to closely monitor N_1 or tail pipe temperature during acceleration, deceleration, or constant speed operation. There is no possibility of accelerating or decelerating the engine too rapidly, and the control will automatically maintain whatever N_1 the pilot requests through the twist grip.

In brief, when the first method of control as outlined above is being used, the pilot uses the twist grip to directly adjust fuel flow. When the second method of control is used, the pilot uses the twist grip to adjust the N_1 governor, which in turn adjusts the fuel flow.

For either of these methods of control, the pilot must constantly monitor N_2 to maintain desired rotor speed. Normal helicopter operation can be maintained through smooth coordination of twist grip movement with collective stick movement.

In the event of a fuel control malfunction which results in an N_2 underspeed, that is, a loss of power, it would be necessary to roll-off the twist grip and flip the pilot selector switch to emergency, using the first method of control outlined above.

The engine is shut down by rolling the twist grip to the flight idle stop, permitting the engine to return to approximately 60 percent N_1 momentarily, then pressing the flight idle button and rolling the twist grip to the full closed position. The pilot monitors the tail pipe temperature during engine shutdown to alert him of any abnormal temperature rise. An automatic fuel shutoff valve (the foot valve mentioned previously) prevents additional fuel from entering the engine, and a valve in the engine automatically drains any remaining unburned fuel from the combustion chamber.

A FEW WEEKS AGO, a small amount of JP-4 fuel was accidentally spilled on the aft cargo door of a UH-1 that was being serviced. Suddenly, the spilled fuel burst into flames, damaging the helicopter before the fire could be extinguished. There had been no open flames, heated objects, or operating electrical or radar equipment nearby. *There had also been no grounding provisions for the helicopter or servicing equipment.* Investigation showed that the ignition source was static electricity.

This was not an isolated instance. Other fires and explosions are know to have originated from static discharges. They have occurred on fuel trucks and carriers of explosives, as well as in such unrelated areas as hospital operating rooms, often with disastrous results. The most spectacular example of a static discharge is also the most familiar — lightning. Conditions similar to those which cause lightning are also responsible for thousands of minute and potentially lethal sparks which occur almost everywhere. Understanding static electricity and how it is generated is a *must* if it is to be controlled and mishaps prevented.

WHAT IT IS

Static electricity is defined as the electricity of stationary charges. These charges are found in positive and negative pairs, and electrification may be developed either by direct contact of two dissimilar substances or by induction (proximity to a charged object). When two different types of materials are brought together, electrons or negative charges migrate from the surface molecules of one substance to those of the other. The substance receiving these electrons is said to become negatively charged, while the substance losing the electrons is said to possess a positive charge. Consequently, the two substances become oppositely electrified. When they are separated, the difference of potential between them may vary from a few volts to several million. The greater the insulating properties of

these surfaces, the greater may be the difference of potential between them.

Accumulation of static charges on a surface is more prevalent during winter months when the moisture content in the air is reduced. The drying of surfaces increases their insulating properties and prevents the flow of accumulated electrons until a charge capable of jumping the intervening air gap has been built up. Consequently, the danger posed by static electricity is much greater during cold, dry seasons than during warm, humid ones.

Sliding across the seat of an automobile or scuffing over thick carpeting on a cold dry day can generate a stored charge of thousands of volts. When an effective ground is contacted, the resultant spark may possess as much as 1,000 times the heat energy required to ignite an explosive mixture of fuel vapor and air. In demonstrations, gas flowing out of open face space heaters has been ignited by such static charges. Similarly, fuel flowing into the tank of a fuel trailer during loading or into the fuel cell of an aircraft during servicing can build up a static electrical charge to a point where it will arc across the compartment opening to the servicing nozzle or to some other nearby circuit to ground. The result can be a fire or explosion. Although friction may appreciably increase electrification in certain substances, such as fibrous materials, contrary to popular belief, it is *not* necessary for the generation of static electricity.

The body of a rubber-tired vehicle can effectively serve as one plate of a condenser, with a capacity for storing thousands of volts of static electricity. The static charge can be built up through contact of the rubber tires with the pavement while the vehicle is in motion or by electrostatic induction when it is at rest. When the wheels are rotating, the tires acquire negative charges (electrons) as the tire tread repeatedly contacts and separates from the pavement. Since like charges repel, while unlike charges attract, the high negative electrification of the tires causes the electrons in the metal of those parts nearest them to move to more remote areas of the vehicle body (fig. 1). These electrons are termed *free* electrons and, if a path is made available, they will flow off to ground.

Electrostatic induction occurs most commonly out of doors from the effects of electrified clouds, particularly the thunderhead variety. A rubber-tired vehicle parked on dry concrete or asphalt surface, for example, can readily become charged

The most spectacular example of a static discharge is also the most familiar . . . lightning. Conditions similar to those which cause lightning are also responsible for thousands of potentially lethal sparks which occur almost everywhere . . .

STATIC SPARKS

. . . hazardous to the uninformed

Ted Kontos

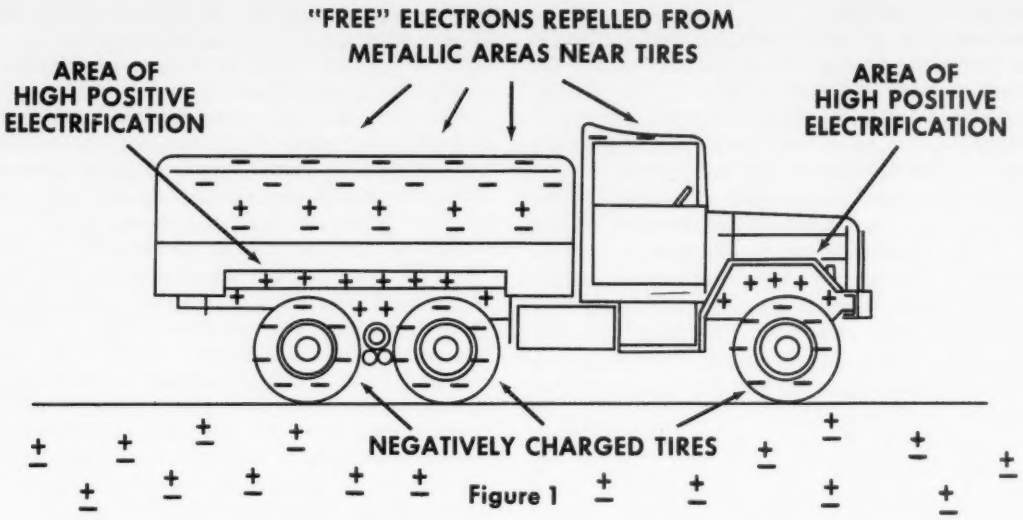

"FREE" ELECTRONS REPELLED FROM METALLIC AREAS NEAR TIRES
AREA OF HIGH POSITIVE ELECTRIFICATION
AREA OF HIGH POSITIVE ELECTRIFICATION
NEGATIVELY CHARGED TIRES

Figure 1

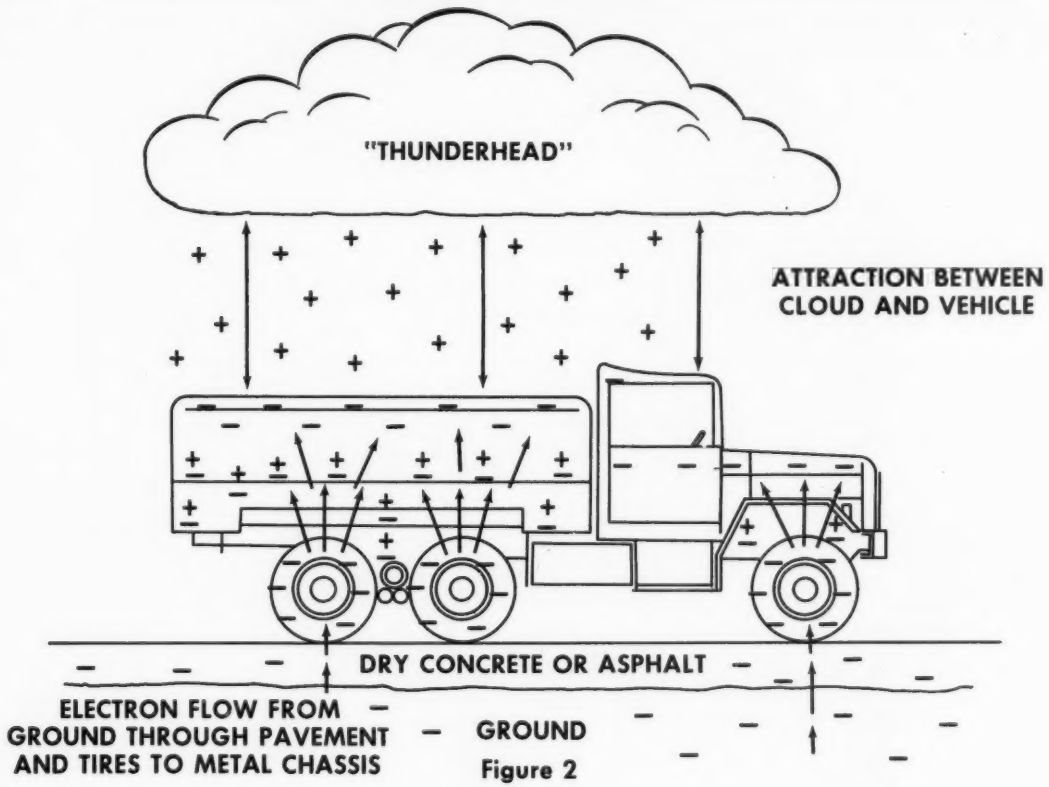

"THUNDERHEAD"
ATTRACTION BETWEEN CLOUD AND VEHICLE
DRY CONCRETE OR ASPHALT
ELECTRON FLOW FROM GROUND THROUGH PAVEMENT AND TIRES TO METAL CHASSIS
GROUND

Figure 2

during the passing of a heavily electrified cloud. The underside of the cloud, charged with positive electricity, causes a powerful electric field between itself and the earth, attracting electrons from the ground into all elevated surfaces. If this attraction is great enough, electrons may jump the air gap between such a surface and the cloud in the form of a lightning bolt. Even if the attraction is not sufficiently great for lightning to occur, electrons will pass through the dry concrete or asphalt to the rubber tires and chassis of a vehicle parked in the area, building up an electrical charge as shown in figure 2.

Because pavement and tires are poor conductors, electrons will flow through them slowly, taking several minutes to an hour to build up a substantial charge. Conversely, once the vehicle has become electrified, the insulating properties of the tires and dry pavement will prevent rapid draining of the charge. This is similar to a wire fence that has become electrified by a bolt of lightning. If the fence is not grounded, it will retain a portion of the charge. Eventually, excess electrons will "bleed" to the ground. Until they do, anyone coming in contact with the fence is apt to receive a jolt. Whether an object is electrified by direct contact with another or by electrostatic induction, if a low resistance path is provided, the accumulated *free* electrons will follow this path, creating a momentary flow of current and, in most instances, a spark.

DANGERS AND CONTROL

Because of the high resistance offered by the insulating properties of his shoes and the concrete he is standing on, a man touching an electrified vehicle may receive an unpleasant shock. This shock is seldom likely to cause injury, except through reflex action. Similarly, liquid fuels do not present a danger in themselves. A spark plug wired to fire while immersed in gasoline will not ignite the fuel. It is only when a mixture of flammable vapors and air are brought in contact with a spark that fires or explosions occur. Since fuels, by their nature, must be volatile, they constantly emit combustible vapors.

If a fuel cell is filled with gasoline and a spark is introduced at the open filler point, a fire will be the most probable result. If the cell is only partially filled, a spark will most likely cause an explosion. The likelihood of preventing the formation of fuel vapors or the generation of static electricity is improbable, if not impossible. The most effective solution requires that a low resistance path to the ground be provided for continuous draining of electrical charges, thus preventing their buildup to a point which will result in a sudden electrical discharge — and spark.

To allow static electrical charges to drain off, aircraft are equipped with ground wires and certain vehicles with drag chains. In reality, such grounding provisions are often ineffective. Under certain conditions, such as dry weather, the resistance of the pavement may often be as high as 1,500 megohms or 150,000 times greater than the 10,000 ohms specified by TM 10-1101 as the maximum permissible resistance for an effective ground. Guards at military installations and industrial plants, as well as ticket collectors at early toll bridges, frequently received jolts when they contacted vehicles, until low resistance antenna-like ground wires were installed *through* the pavement. These devices contacted the metal chassis of vehicles, permitting the accumulated static electricity to drain off. Similar provisions are mandatory for effective grounding of aircraft, vehicles, and other equipment.

FACTS TO REMEMBER

- Generation of static electricity cannot be easily prevented.
- The energy required in static sparks to ignite the most explosive vapors is very small.
- Static electricity is a greater hazard in winter than in summer.
- A fueling trailer can serve as one plate of a capacitor, capable of storing thousands of volts of static electricity.
- Although friction may appreciably increase the electrification in fibrous substances, friction is not necessary for the generation of static electricity. Wool or fabrics made of synthetic fibers should not be used in an explosive atmosphere.
- Elimination of the static electricity hazard calls for preventing accumulation rather than generation of static charges.
- During fuel transfer operations, equipment (aircraft, fuel trucks, etc.) should be bonded to each other as well as provided with an effective ground.
- In most applications, a safe resistance to ground is approximately 10,000 ohms or less. Keep in mind that frayed wires, rust, grease, etc., will increase the resistance and decrease the effectiveness of a ground.
- Do not service aircraft during the approach of an electrical storm.
- TM 10-1101 should be consulted for additional information and safety procedures.

LETTERS

Continued from page 1

• The following answer was supplied by USAAVN Cen/Sch Personnel Division:

Temporary award—Aircraft Crewman Badge: The commander of any Army unit which has assigned Army aircraft may authorize in published orders qualified personnel of his command to wear the Aircraft Crewman Badge. An individual must be on flying status as a crewmember in the case of crewchiefs, airborne electronic sensory system operators, and supervisors and flight engineers or as a non-crewmember in the case of observers, medical aidmen, gunners, aircraft maintenance supervisors or technical inspectors, physically qualified, Class III, and be qualified for and hold a principal duty assignment as a crewchief, flight engineer, aircraft maintenance supervisor, observer, gunner or technical inspector. Concurrent with such assignment, these personnel are authorized to wear the Aircraft Crewman Badge until relieved from such duty or until such time as he fulfills the mandatory requirements for permanent award.

Permanent award: An individual who has performed in one of the duties specified above for not less than 12 months (not necessarily consecutive) or is school trained (for aircraft maintenance supervisor or technical inspector, only conducted at Ft Eustis, Va.) will be authorized to wear the Aircraft Crewman Badge permanently.

CPT Ferguson's answer to SSG Campbell only pertained to award of the Senior Aircraft Crewman Badge.

Sir:

While cruising fat, dumb, and happy at 3,000 feet on another otherwise boring, uneventful flight in Vietnam, the day was suddenly changed drastically to one of shock, concern, and a trace of terror.

A UH-1 Dustoff medical evacuation helicopter was en route from Tuy Hoa to Nha Trang with a patient and four passengers, a total of nine counting the crew on board. As was the custom, they were flying along the coastline over the water to avoid Viet Cong sniper fire along the shore. While crossing a large bay, extending the flight path 2½ miles from shore, two banging noises were heard, the EGT rose rapidly to 800°, and the engine failed. An autorotation was immediately executed, rotor rpm was regained and an attempt was made to get back to shore.

It soon became apparent that they could not make it to land and they were going to have to ditch in the South China Sea. Rather than attempt to stretch the touchdown in the last few feet and possibly hit hard, emphasis was placed on as smooth a landing as possible. Basically the proper ditching procedures were used, except that the pilot used the surface of the water exactly as he would have used a land surface.

The landing was accomplished with zero water speed and collective pitch was applied approximately 8 to 10 feet above the water. As the helicopter slowly sank in the water, full right cyclic was applied to roll the helicopter on its right side. The right doors and windows were closed, but the left doors were open. As the helicopter rolled over to the right, the passengers, patient and crew, except for the pilot, exited through the left doors.

As a result of the people exiting from the left doors and high waves hitting the helicopter, it rolled back to its left side. As the right side cleared the water and water began pouring into the helicopter through the left doors, the pilot attempted to jettison his right door, but it would not jettison. By this time the water was coming over his head and he tried to dive out the left door. After meeting resistance, he discovered that he still had his seat belt on. Unbuckling his belt, he dived out the left door and surfaced without further problems.

All persons exited the sinking helicopter without problem except for the first passenger who was struck by the main rotor blade as it rocked back; he was not recovered. All remaining persons assembled around the helicopter, which floated for approximately one minute upside down and then sank without creating a vacuum pull. The overwater survival kit sank with the helicopter and only the two pilots had on life preservers. Each of them doubled up with those not having life preservers and the entire remaining group swam approximately ¼ to ½ mile to a coral reef. Although sharks were plentiful in the area, none were sighted, so the available shark repellent was not used.

Apparently placing the transponder in emergency and broadcasting a Mayday on the way down was effective. Fixed wing aircraft began to circle the area and in approximately 30-40 minutes, a Dustoff rescue helicopter arrived and made a daring rescue by hovering with skids in the water while two crewmembers lifted the personnel from the choppy sea. The extrication from the water was necessitated when the steep coral reefs prevented climbing from the water.

An actual ditching adds personal interest to some of the following suggestions:

• Have enough life vests for everyone and wear them.

• Wait until the landing is completed before releasing seat belts, and keep your helmet on until you have cleared the helicopter itself.

• Watch out for the rotor blades and the helicopter itself.

• Don't inflate life vest until you are in the water and outside the aircraft.

• Weigh the advantages of removing boots, pants, gloves, etc., to aid swimming against the need for these items if you make land.

• Have a good plan for ditching and get your survival gear out of the aircraft with you.

• Have pocket flares on your person (they work well even after being submerged)—pen gun flare FSN 1370-921-6172.

• Give complete overwater briefing to all personnel before the flight, combat situation permitting.

MAJ DONALD R. HULL
Munson Army Hospital
Fort Leavenworth, Kan. 66027

Sir:

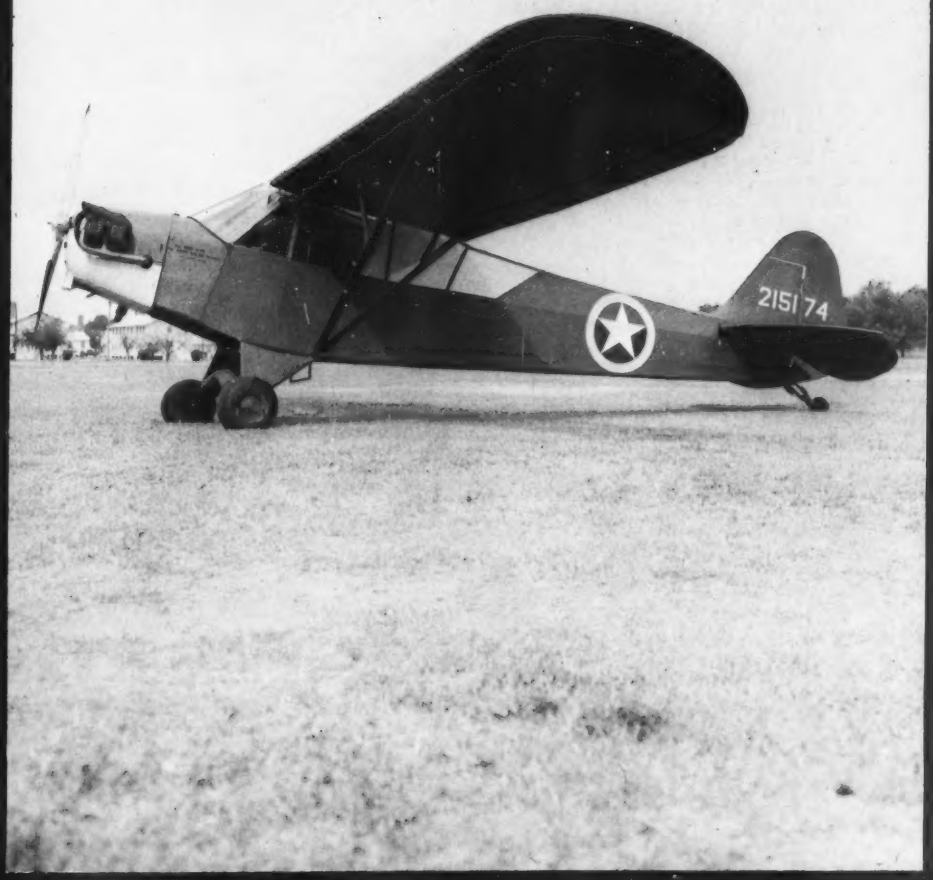
Just a note to correct an error which appeared in the Oct 67 issue of your magazine, "Army's Oldest Huey Is WIA." You state in the article that 107 (62-2107) was assigned to the 227th Aviation Battalion, 1st Air Cavalry Division. The truth of the matter is that 107, since her assignment to an aviation unit, has always been the property of Co B, 229th Aviation Battalion (Assault Helicopter), 1st Air Cavalry Division. She is not the oldest Huey in the Army; rather 107 is now the oldest production line D model, 62-2106 having been destroyed earlier in Vietnam. According to the Bell "tech reps" stationed here in An Khe, 107 set the rotary wing altitude record just prior to joining the 1st Cav.

Since her first wound during the opening assaults of Operation Pershing, 107 has sustained other injuries, having been hit by exploding 105 mm shells detonated by a fire at landing zone English on 6 June 67. She was also damaged when she was dropped by the CH-47 Chinook that was carrying her to the Huey hospital at the 15th TC Battalion in An Khe. Postoperative reports from the 610th TC Company indicate that the old girl has completely recovered and should be back in action shortly. This news will make one CPT Hoke Garret and CW3 D. Howard very happy seeing as they were the maintenance officers for B/229th and showered 107 with one hell of a lot of TLC (tender loving care).

Thank you for this opportunity to set the record straight concerning one of our pride and joys.

LT JOSEPH MIRABELLA
HHC, 229th Avn Bn (AH)
1st Air Cavalry Division
APO San Francisco 96490

This U. S. Army L-4 recently was restored by U. S. Army Aviation Museum personnel to near-original condition for display at the annual AAAA and AUSA meetings in Washington, D. C. The L-4 was the first Army Ground Forces aircraft in combat.



° U.S.ARMY L-4 °

FOR A MERRY
CHRISTMAS
EVERY YEAR,
KNOW, CARE FOR,
AND USE YOUR
PERSONAL
EQUIPMENT AND
SURVIVAL GEAR.